HighWire-MTP2 Software Reference

Rev. 1.2, September 4, 2002

Primary Text Number M8245

SBE, Inc.

2305 Camino Ramon, Suite 200, San Ramon, California 94583

(925) 355-2000 Technical Support (800) 444-0990

Fax: (925) 355-2020 FaxBack Service: (800) 214-4723

website: http://www.sbei.com

Copyright ©2001, 2002 by Data Connection Limited, Inc. All rights reserved.

Copyright ©2001, 2002 by SBE, Inc. All rights reserved.

No part of this manual may be reproduced by any means without written permission from SBE, Inc., except that the purchaser may copy necessary portions for internal use only.

While every effort has been made to ensure the accuracy of this manual, SBE cannot be held responsible for damage resulting from information herein. All specifications are subject to change without notice.

SBE, Inc. and the SBE logo are trademarks of SBE, Inc.

Sun, Sun Microsystems, the Sun Logo, and Solaris are trademarks or registered trademarks of Sun Microsystems, Inc. in the United States and other countries.

VxWorks is a registered trademark of Wind River Systems, Inc.

About SBE, Inc. SBE, Inc., provides a broad range of intelligent communications controllers used primarily in networking systems applications. These products are sold worldwide through direct sales and distribution channels.

SBE is based in San Ramon, California, and can be reached at 925-355-2000 or online at http://www.sbei.com

Contents

1. About This Manual 9
1-1. Related Documents 9
1-2. Documentation Conventions 9

2. Software Installation and Removal 11
2-1. Software Installation 11
2-2. Software Removal 12
2-3. Hot Plug Overview 12
2-3-1.Terminology 13
2-3-2.RCM overview 13
2-3-3.hw_daemon monitoring of hardware status 13
2-3-4.Daemon assignment 14
2-3-5.Configure a board for basic hot swap 14
2-3-6.Remove a basic hot swap enabled board 14
2-3-7.Sample -pkgadd- command output 15
2-3-8.Sample -pkgrm- command output 20

3. Introduction to HighWire-MTP2 25
3-1. HW400 Boards 25
3-1-1.HW400c 25
3-1-2.HW400p 26
3-2. HW-MTP2 Interface Overview 27
3-3. Theory of Operation 28

4. Cross Bus Interface 29
4-1. Functional Overview 29
4-1-1.HWMTP2 for Solaris 29
4-1-2.HWMTP2 for SDK 30
4-2. Using the Cross Bus Interface 30
4-2-1.Initialization and termination 30
4-2-2.Opening and closing a connection to a line card 30
4-2-3.Opening and closing a sub-interface 30
4-2-4.Connecting to and disconnecting from an MTP2 instance 31
4-2-5.Sending messages to MTP2 31
4-2-6.Receiving messages from MTP2 32
4-2-7.Send-side flow control (HWMTP2 for Solaris only) 32
4-2-8.Receive-side flow control 33
4-3. Basic Interface Functions and API Calls 34
4-3-1.cbi_initialize 34
4-3-2.cbi_terminate 35
4-3-3.cbi_open 35
4-3-4.cbi_close 36
4-3-5.cbi_recv 36
4-3-6.cbi_send 37

4-3-7.CBI_MSG_AVAIL_CALLBACK 38

5. HW-MTP2 Level 2 - Level 3 Interfaces and Message Flows 39
5-1. Level 2 - Level 3 Management Interface 39
5-2. Level 2 - Level 3 Data Interface 40
5-3. Message Flows 41
5-3-1.Link activation 42
5-3-2.Remote Processor Outage (RPO) 43
5-3-3.Changeover following local detection of link failure 46
5-3-4.Failover of MTP3 Control Part 47
5-3-5.MTP3 Data Part failure 48
5-3-6.MTP3 Data Part unavailability 48

6. CBI Buffer Formats 49
6-1. Common Header Sub-Structures 49
6-1-1.CBI_M2_COMMON_PARMS 49
6-1-2.CBI_M2_MTP2_PARMS 52
6-1-3.CBI_M2_SAAL_PARMS 57
6-1-4.CBI_PKT_HDR 57
6-2. CBI Message Summary 57
6-2-1.Signals sent from L3 to L2 57
6-2-2.Signals sent from L2 to L3 59
6-3. CBI Messages: Detailed Description 61
6-3-1.CBI_M2_AVAILABLE 61
6-3-2.CBI_M2_BSNT 61
6-3-3.CBI_M2_BSNT_NOT_RETRIEVABL 62
6-3-4.CBI_M2_CLEAR_RTB 62
6-3-5.CBI_M2_CLOSE 63
6-3-6.CBI_M2_CONTINUE 63
6-3-7.CBI_M2_CREDIT 64
6-3-8.CBI_M2_CREDIT_ERROR 65
6-3-9.CBI_M2_EMERGENCY 65
6-3-10.CBI_M2_EMERGENCY_ CEASES 66
6-3-11.CBI_M2_EV_INDICATION 66
6-3-12.CBI_M2_EV_REGISTER 68
6-3-13.CBI_M2_EV_UNREGISTER 70
6-3-14.CBI_M2_FLUSH_BUFFERS 71
6-3-15.CBI_M2_IN_SERVICE 72
6-3-16.CBI_M2_LINK_ CONGESTED 72
6-3-17.CBI_M2_LINK_CONGSTN_CEASED 73
6-3-18.CBI_M2_LOC_PROCSSR_ OUTAGE 73
6-3-19.CBI_M2_LOC_PROCSSR_ RECOVRD 74
6-3-20.CBI_M2_REGISTER 74

6-3-21.CBI_M2_UNREGISTER 76
6-3-22.CBI_M2_MSG_FOR_
XMISSION 77
6-3-23.CBI_M2_OPEN 78
6-3-24.CBI_M2_OUT_OF_SERVICE 80
6-3-25.CBI_M2_QUERY_CONFIG 81
6-3-26.CBI_M2_QUERY_STATS 82
6-3-27.CBI_M2_QUERY_STATUS 86
6-3-28.CBI_M2_RB_CLEARED 89
6-3-29.CBI_M2_RECEIVED_
MESSAGE 90
6-3-30.CBI_M2_REM_PROCSSR_OUTAGE 91
6-3-31.CBI_M2_REM_PROCSSR_
RECOVRD 91
6-3-32.CBI_M2_RETRIEVAL_
COMPLETE 92
6-3-33.CBI_M2_RETRIEVAL_NOT_POSS 92
6-3-34.CBI_M2_RETRIEVAL_REQ_
FSNC 93
6-3-35.CBI_M2_RETRIEVED_
MESSAGE 93
6-3-36.CBI_M2_RETRIEVE_BSNT 94
6-3-37.CBI_M2_RTB_CLEARED 94
6-3-38.CBI_M2_START 95
6-3-39.CBI_M2_STOP 95
6-3-40.CBI_M2_UNAVAILABLE 96
6-3-41.CBI_M2_UPDATE_PARMS 96

7. Data Path Routing (DPR) 99
7-1. dprservice (7D) 99
Synopsis 99
Availability 100
Commands 100
7-2. libdpr (3sbe) 116
Synopsis 116
Availability 116
Routines 116
7-3. sbe_dprOpen 117
Synopsis 117
Return values 117
See also 117
7-4. sbe_dprClose 117
Synopsis 117
Return values 117
See also 117
7-5. sbe_dprRead 117

Synopsis 117
Return values 117
See also 117
7-6. sbe_dprWrite 118
Synopsis 118
Return values 118
See also 118
7-7. sbe_dprIoctl 118
Synopsis 118
Commands 118
Return values 128
See also 128
7-8. sbe_dprConfigDefault 129
Synopsis 129
Return values 129
See also 129
7-9. sbe_dprConnectionReport 129
Synopsis 129
Return values 129
See also 129
7-10. sbe_dprHighwayReport 129
Synopsis 129
Return values 129
See also 129
7-11. sbe_dprPrint 130
Synopsis 130
Return values 130
See also 130

8. Appendix A: Test and Library Files 131
8-1. CBI Files 131
8-1-1.CBI library source files (for Solaris) 131
8-1-2.CBI include files (for Solaris) 131
8-1-3.CBI include files (for SDK) 131
8-1-4.CBIPTEST program (for Solaris) 131
8-1-5.Utility files 131
8-1-6.cbiDemo program 131
8-2. Compiling the CBIPTEST Program 132
8-3. Running the CBIPTEST Program 132
8-4. Compiling the cbiDemo Program under SDK 133
8-5. Running the cbiDemo Program under SDK 133
8-6. Compiling cbiDemo Program under Solaris 133
8-7. Running the cbiDemo Program under Solaris 133
8-8. CBIPTEST Program Console Printout 133
8-9. cbiDemo Program Console Printout 135

9. Appendix B: Code Values 137

9-1. CBI Function Return Codes 137
9-2. CBI Return Codes 138
9-3. CBI_YES_NO 138
9-4. CBI_MTP2_IPS_TYPES 139
9-5. CBI_M2_MAJOR_VARIANT 140
9-6. CBI_M2_LPO_STATES 141
9-7. CBI_M2_UPS_TYPES 141
9-8. CBI_M2_PS_PROVING_TYPES 141
9-9. CBI_M2_EV_TYPES 142
9-10. CBI_M2_UPDATE_TYPES 142
9-11. CBI_M2_CONG_LEVELS 143
9-12. CBI_CONG_CTRL 143
9-13. CBI_ERR_METHOD 143
9-14. CBI_XMIT_RATE 144
9-15. CBI_IN_SERVICE_MONITOR_TYPES 144
9-16. CBI_M2_LINK_STATUS 144
9-17. L1_FRAMING 145
9-18. L1_CLOCKING 145
9-19. L1_LINE_TYPE 145
9-20. L1_LINE_CODE 146
9-21. L1_LINE_BUILD_OUT 146

10. Appendix C: Manpages 147
10-1. Table of Manpages 147

11. Appendix: cbiDemo.c and dprDemo.c 149
11-1. cbiDemo.c 149
11-2. dprDemo.c 149

Figures

3-1 HW-MTP2 Level2 - Level 3 interfaces 27
3-2 HighWire-MTP2 theory of operation 28
5-1 Message flows involved in registering with an L2 process and activating a link. 42
5-2 Message flows involved when the remote end of the link suffers a processor outage. 43
5-3 Message flows involved when the remote end of the link suffers a processor outage. 44
5-4 Message flows involved when the remote end of the link suffers a processor outage. 44
5-5 Message flows involved when the remote end of the link suffers a processor outage. 45
5-6 Message flows involved when L2 detects that a link has failed 46
5-7 Message flows involved after failover of the control part of MTP3 has occurred. 47
5-8 Message flows involved when the data part of MTP3 fails and is immediately replaced. 48
5-9 Message flows involved when the data part of MTP3 fails and is not immediately replaced. 48

Tables

4-1 Sequence of events in disconnections 31
10-1 Manpages 147

1. About This Manual

This manual enables a third party to write applications making use of the MTP2 protocol executing on SBE's HW400 board.

The *HighWire-MTP2 Software Reference* manual covers the following topics:

- Software installation
- Cross Bus Interface
- MTP Layer 2 - Layer 3 management interface
- MTP Layer 2 - Layer 3 data interface

1-1. Related Documents

- HighWire™ HW400c High-Performance Compact PCI Communications Controller Hardware Technical Reference
- HW400p High-Performance PCI Communications Controller Hardware Technical Reference
- HW400 Product Series Software Development Kit (SDK) Software Technical Reference
- ITU Q.700 Series Specifications
- ANSI T1.100, T1.111

1-2. Documentation Conventions

Registers — Register bits are numbered starting with 0. Bit 0 is the least significant and bit 7 is the most significant bit of a byte. Unless otherwise noted, register bits that are identified as "unused" do not affect the function of the register, and, if read, yield no information.

Signals — When referring to a signal function in text, signal names do not indicate polarity, and the / is not used. Occasionally a signal name may be followed by an asterisk (*), a pound sign (#) after the name, or with a / in front of the signal name. These are valid ways of indicating active low signals.

`Code` — **`Code is represented in New Courier typeface.`**

2. Software Installation and Removal

2-1. Software Installation

Software packages contained on the CDROM within the /cdrom/pkg directory reflect the Solaris operating system version with which the software is associated.

- hw6mtp_ga_1_0.sbe
- hw8mtp_ga_1_0.sbe
- hw9mtp_ga_1_0.sbe

hw9 reflects Solaris 9; hw8 reflects Solaris 8; hw6 reflects Solaris 2.6. The ga_X_X portion indicates that the package is an General Access product with a release level of 1.0.

The following example demonstrates installation of the Solaris 8 HighWire MTP2 package. Other packages are similarly installed.

1. Install the boards into the system.
2. Log in as root. You must have SuperUser privileges to install this package.
3. Insert the HighWire MTP-2 Software Package CD-ROM.
4. Change the directory to /pkg on the CD-ROM (or a system specified CD-ROM drive: cd /cdrom/pkg
5. Add the software package, using the appropriate version for your environment:
   pkgadd -d hw8mtp_ga_1_0.sbe SBEhw

Note: The package utilities may fail to attach the board. Continue to Section 2-3-5, *Configure a board for basic hot swap*, to complete attaching the board to the system. On some systems, it may be necessary to perform a reconfiguration reboot. (System Ref: boot(1M))

2-2. Software Removal

1. Log in as root. You must have SuperUser privileges to install this package.
2. Issue the Package remove command: pkgrm SBEhw
3. Answer “Y” to the following prompt:

```
The following package is currently installed:
SBEhw SBE HighWire, Solaris 8 Driver w/MTP2 service
Do you want to remove this package?
```

4. Answer “Y” to the following prompt:

```
Removing installed package instance <SBEhw>
This package contains scripts which will be executed with super-user
permission during the process of removing this package [y,n,?,q]
.
.
.
```

2-3. Hot Plug Overview

Hot plugging is the ability to physically add, remove, or replace system components while the system is running. Dynamic reconfiguration, available on certain SPARC servers, allows a service provider to remove and replace hot-pluggable system I/O boards in a running system, eliminating the time lost in rebooting.

Note that Hot Plug technology is a precursor of Hot Swap. In Hot Plug mode, the hardware connection or disconnection has to be manually performed by turning the corresponding slot on or off. The implementation is left to the discretion of the system manufacturer. Under Solaris, the cfgadm command is used to support Hot Plug.

See your SPARC hardware manufacturer's documentation to determine if your system supports dynamic reconfiguration. SBE HighWire adapters are PCI controllers that support hot-plugging. Refer to Solaris documentation describing how to use the cfgadm command to hot-plug PCI controllers.

The SBE HighWire and LinkWARE software packages support Hot Swap and Hot Plug. The HighWire adapters are PCI-compliant. Per Solaris documentation, each piece of hardware that supports Dynamic Reconfiguration (DR) must supply a hardware-specific library. The PCI hardware specific library /usr/lib/cfgadm/pci.so.1 provides support for hot plugging PCI adapter cards into PCI hot-pluggable slots in a hot plug capable system, through cfgadm(1M). (System Ref: cfgadm_pci(1M))

Depending on the version of the boot eprom installed on the SBE HighWire adapter, the board's cfgadm Type field may be either a network or a bridge.

```
# cfgadm
# pci_pci0:cpci_slot4 network/fhs connected configured ok
```

2-3-1. Terminology

Basic Hot Swap	Hardware connection is automatic but the software connection and failover process is manual.
Full Hot Swap	Hardware connection is automatic, software connection is automatic, but the failover process is manual.
HA Hot Swap	Hardware connection is automatic, software connection is automatic, and the failover process is automatic as well.

See the hardware-specific documentation of your Solaris system for details of its System Configuration Administration support.

2-3-2. RCM overview

The Reconfiguration Coordination Manager (RCM) is the framework that manages the dynamic removal of system components. SBE HighWire software packages supply a RCM script for releasing a board's daemon and control device in an orderly manner. Applications using HighWire resources must release their own resources during dynamic removal of HighWire components. The RCM feature was added within the Solaris 8 4/01 release and is also available on Solaris 9.

RCM commands are invoked only for the resources whose subsystems participate within the RCM framework. Currently, not all Solaris subsystems participate within this framework.

(System Ref: rcmscript(4), highwire.rcm (1M))

2-3-3. hw_daemon monitoring of hardware status

The hw_daemon process continually monitors board availability as part of its Hot Swap support. Upon board removal, re-insertion, and configuration, the daemon will restart the SBE HighWire adapter without further administration intervention.

(System Ref: hw_daemon(1M))

2-3-4. Daemon assignment

The SBE HighWire family of products operates under control of a daemon that monitors status and controls access. The daemon is called wspd. There is a separate wspd daemon for each HighWire adapter in the system.

The Process ID of the daemon associated with a particular board is available through the hwinfo command.

Example:

`hwinfo -i 1  returns information about board 1.`

Below is a sample entry.

```
*** HighWire Information for Board #1 ***
Device Type    : HW400c/R
Device S/N     : 90528
Device Info    : Brdno= 1  Bus= 3  Slot= 4  irq= 0  addr= c000000
Device Status  : 1 of 130 queues open, 0 closes pending
Control Device : /dev/hw1_ctl
Control Link   : /devices/pci@1f,0/pci@1/pci@1/pci1176,600@e:1,ctl,type1
Control PID    : 140
Driver Release : SBE HighWire Driver, Version SOL6_HWMTP_GA_1_0 (Tue Aug 27 17:31:58 PDT 2002)
Driver Intrface: @(#) HMQ interface 2.1.4
PDM Release    : $Release: HW400_HWMTP2_FOR_SOL_GA_1_0,  Copyright (c) 2002 SBE, Inc.$
VXBOOT Release : $Release: VXBOOT_400_1_1,   Copyright (c) 2001 SBE, Inc.$
```

Thus, board number 1 (Brdno) is in Slot 4 (Slot) under control of the wspd whose Control Process ID (Control PID) is 140.

Note: There is no correlation between the Board instance (Brdno) number and the board's slot number. The instance number is assigned according to the sequence in which boards are initially discovered by the Solaris operating system. However, the assignment of instance number to slot number can be administered via the system's /etc/path_to_inst file. See the section within wsp(7d) for an example.

(System Ref: hwinfo(1M))

2-3-5. Configure a board for basic hot swap

Certain Solaris servers support basic hot swap by default. This means that if a board is newly inserted, you must manually activate the I/O slot using the cfgadm command after the board has been inserted.

Refer to your specific system's documentation for the correct configuration procedure. SBE HighWire adapters adhere to the standard PCI HotSwap hardware architecture.

Once a board is powered up and configured into the system, restarting the board's software occurs automatically via the package's hw_daemon.

2-3-6. Remove a basic hot swap enabled board

Certain Solaris servers support **basic** hot swap by default. This means that if a board becomes faulty and needs replacing, you must manually deactivate the I/O slot using the *cfgadm* command before you can remove the board, and then manually reactivate the I/O slot after replacing the board. To successfully remove a board, you must also terminate any applications or daemons currently using a board's devices.

Certain systems may require manual termination of the board's controlling daemon. Locate the board's daemon process number (Control PID) using the HighWire *hwinfo* command (see the Daemon Assignment section, above). Then terminate the board's controlling daemon, using the *hwcmd* command.

Example: `hwcmd -r 1`

Refer to your specific system's documentation for the correct procedure to unconfigure a board.

You must have SuperUser privileges to unconfigure a board.

2-3-7. Sample -pkgadd- command output

Certain systems may require manual termination of the board's controlling daemon. Locate the board's daemon process number (Control PID) using the HighWire *hwinfo* command (see the Daemon Assignment section, above). Then terminate the board's controlling daemon, using the *hwcmd* command.

Example: `hwcmd -r 1`

Refer to your specific system's documentation for the correct procedure to unconfigure a board.

You must have SuperUser privileges to unconfigure a board.

Sample -pkgadd- Command Output

```
# cd /cdrom/pkg
# pkgadd -d hw8mtp_ga_1_0.sbe SBEhw
Processing package instance <SBEhw> from <cdrom/pkg/
hw8mtp_ga_1_0.sbe>
SBE HighWire, Solaris 8 Driver w/ MTP2 service.
(sparcv9) REL: SOL8_HWMTP_GA_1_0
---------------------------------
| Copyright 2000-2002, SBE, Inc. |
---------------------------------
This information is the confidential property
of SBE, Inc. and may not be reproduced, disclosed
or otherwise used in whole or in part except as
authorized by written permission from SBE, Inc.
## Executing checkinstall script.
## Processing package information.
## Processing system information.
## Verifying disk space requirements.
## Checking for conflicts with packages already
installed.
## Checking for setuid/setgid programs.
This package contains scripts which will be executed with
super-user
permission during the process of installing this package.
Do you want to continue with the installation of <SBEhw>
[y,n,?] y
Installing SBE HighWire, Solaris 8 Driver w/ MTP2
service. as <SBEhw>
## Executing preinstall script.
>> Cleaning up HighWire entries in devlink.tab file.
>> Cleaning up HighWire entries in minor_perm file.
```

```
## Installing part 1 of 1.
/etc/opt/SBEhw/cfg/wsp.conf
/etc/opt/SBEhw/cfg/wspcfgfile.hw400
/etc/opt/SBEhw/cfg/wspcmd.cfg
/opt/SBEhw/bin/hw_daemon
/opt/SBEhw/bin/hwcmd
/opt/SBEhw/bin/hwinfo
/opt/SBEhw/bin/hwstat
/opt/SBEhw/bin/release.sh
/opt/SBEhw/bin/wspcmd
/opt/SBEhw/bin/wspd
/opt/SBEhw/dev/devlink.tab.hw
/opt/SBEhw/pdm/pdm.hw400 <symbolic link>
/opt/SBEhw/pdm/pdm.map400 <symbolic link>
/opt/SBEhw/pdm/pdm_hwmtp.hw400
/opt/SBEhw/pdm/pdm_hwmtp.map400
/usr/kernel/drv/sparcv9/wsp
/usr/kernel/drv/wsp
/usr/kernel/drv/wsp.conf <symbolic link>
/usr/sbin/hw_daemon <symbolic link>
/usr/sbin/hwcmd <symbolic link>
/usr/sbin/hwinfo <symbolic link>
/usr/sbin/hwstat <symbolic link>
/usr/sbin/wspcmd <symbolic link>
/usr/sbin/wspd <symbolic link>
[ verifying class <Driver> ]
/etc/init.d/sbehwd
/etc/rc0.d/K50hwd <symbolic link>
/etc/rc1.d/K50hwd <symbolic link>
/etc/rc2.d/S58hwd <symbolic link>
/opt/SBEhw/bin/cbiDemo <symbolic link>
/opt/SBEhw/bin/cbiDemo_32
/opt/SBEhw/bin/cbiDemo_64
/opt/SBEhw/bin/cbiptest <symbolic link>
/opt/SBEhw/bin/cbiptest_32
/opt/SBEhw/bin/cbiptest_64
/opt/SBEhw/bin/dprDemo <symbolic link>
/opt/SBEhw/bin/dprDemo_32
/opt/SBEhw/bin/dprDemo_64
/opt/SBEhw/bin/echoDemo <symbolic link>
/opt/SBEhw/bin/echoDemo_32
/opt/SBEhw/bin/echoDemo_64
/opt/SBEhw/doc/cbiDemo.htm
/opt/SBEhw/doc/cbiptest.htm
/opt/SBEhw/doc/dprDemo.htm
/opt/SBEhw/doc/dprservice.htm
/opt/SBEhw/doc/highwire_rcm.htm
/opt/SBEhw/doc/hw_daemon.htm
/opt/SBEhw/doc/hwcmd.htm
/opt/SBEhw/doc/hwinfo.htm
/opt/SBEhw/doc/hwstat.htm
/opt/SBEhw/doc/libdpr.htm
/opt/SBEhw/doc/libsbe.htm
/opt/SBEhw/doc/manpages.htm
```

```
/opt/SBEhw/doc/sbe_BoardReady.htm
/opt/SBEhw/doc/sbe_ctlClose.htm
/opt/SBEhw/doc/sbe_ctlIssueMsg.htm
/opt/SBEhw/doc/sbe_ctlOpen.htm
/opt/SBEhw/doc/sbe_ctlRcvMsg.htm
/opt/SBEhw/doc/sbe_dataOpen.htm
/opt/SBEhw/doc/wsp.htm
/opt/SBEhw/doc/wsp_conf.htm
/opt/SBEhw/doc/wspcmd.htm
/opt/SBEhw/doc/wspcmd_cfg.htm
/opt/SBEhw/doc/wspd.htm
/opt/SBEhw/lib/libcbi.so
/opt/SBEhw/lib/libsbe.a
/opt/SBEhw/lib/libsbe.so
/opt/SBEhw/lib/sparcv9/libcbi.so
/opt/SBEhw/lib/sparcv9/libsbe.a
/opt/SBEhw/lib/sparcv9/libsbe.so
/opt/SBEhw/src/include/sbe/bi_err.h
/opt/SBEhw/src/include/sbe/cbi/cbi.h
/opt/SBEhw/src/include/sbe/cbi/cbicssif.h
/opt/SBEhw/src/include/sbe/cbi/cbim2.h
/opt/SBEhw/src/include/sbe/ctrld_if.h
/opt/SBEhw/src/include/sbe/dpr/connmgr.h
/opt/SBEhw/src/include/sbe/dpr/dpr_driver.h
/opt/SBEhw/src/include/sbe/dpr/t8102.h
/opt/SBEhw/src/include/sbe/dpr/ttsi2k32t.h
/opt/SBEhw/src/include/sbe/dprd_if.h
/opt/SBEhw/src/include/sbe/sbe_dprlib.h
/opt/SBEhw/src/include/sbe/sbe_lib.h
/opt/SBEhw/src/include/sbe/sbe_std.h
/opt/SBEhw/src/include/sbe/sbe_types.h
/opt/SBEhw/src/include/sbe/uppa.h
/opt/SBEhw/src/include/sbe/wsp_brd_prop.h
/opt/SBEhw/src/include/sbe/wsp_que_prop.h
/opt/SBEhw/src/include/sbe/wspusr.h
/opt/SBEhw/src/include/sbe/wx/a0l2l3d.h
/opt/SBEhw/src/include/sbe/wx/a0l2l3m.h
/opt/SBEhw/src/include/stdint.h
/usr/include/sbe <symbolic link>
/usr/lib/libcbi.so <symbolic link>
/usr/lib/libsbe.a <symbolic link>
/usr/lib/libsbe.so <symbolic link>
/usr/lib/rcm/scripts/SBEI,highwire.sh
/usr/lib/sparcv9/libcbi.so <symbolic link>
/usr/lib/sparcv9/libsbe.a <symbolic link>
/usr/lib/sparcv9/libsbe.so <symbolic link>
/usr/share/man/man1m/highwire_rcm.1m
/usr/share/man/man1m/hw_daemon.1m
/usr/share/man/man1m/hwcmd.1m
/usr/share/man/man1m/hwinfo.1m
/usr/share/man/man1m/hwstat.1m
/usr/share/man/man1m/wspcmd.1m
/usr/share/man/man1m/wspd.1m
/usr/share/man/man3/libsbe.3
```

```
/usr/share/man/man3x/sbe_BoardReady.3x
/usr/share/man/man3x/sbe_ctlClose.3x
/usr/share/man/man3x/sbe_ctlIssueMsg.3x
/usr/share/man/man3x/sbe_ctlOpen.3x
/usr/share/man/man3x/sbe_ctlRcvMsg.3x
/usr/share/man/man3x/sbe_dataOpen.3x
/usr/share/man/man4/wsp.conf.4
/usr/share/man/man4/wspcmd.cfg.4
/usr/share/man/man6/cbiDemo.6
/usr/share/man/man6/cbiptest.6
/usr/share/man/man6/dprDemo.6
/usr/share/man/man7d/wsp.7d
/usr/share/man/sman3sbe/libdpr.3sbe
/usr/share/man/sman3sbe/sbe_dprClose.3sbe
/usr/share/man/sman3sbe/sbe_dprConfigDefault.3sbe
/usr/share/man/sman3sbe/sbe_dprConnectionReport.3sbe
/usr/share/man/sman3sbe/sbe_dprHighwayReport.3sbe
/usr/share/man/sman3sbe/sbe_dprIoctl.3sbe
/usr/share/man/sman3sbe/sbe_dprOpen.3sbe
/usr/share/man/sman3sbe/sbe_dprPrint.3sbe
/usr/share/man/sman3sbe/sbe_dprRead.3sbe
/usr/share/man/sman3sbe/sbe_dprWrite.3sbe
/usr/share/man/sman7d/dprservice.7d
[ verifying class <System> ]
/opt/SBEhw/src/cbi_demo/Makefile.gnu
/opt/SBEhw/src/cbi_demo/Makefile.sunw
/opt/SBEhw/src/cbi_demo/cbiDemo.c
/opt/SBEhw/src/cbi_demo/makecom
/opt/SBEhw/src/cbi_demo/sbe/cbi/cbiDemo.h
/opt/SBEhw/src/cbi_demo/sbeRelease.c
/opt/SBEhw/src/cbiptest/Makefile.gnu
/opt/SBEhw/src/cbiptest/Makefile.sunw
/opt/SBEhw/src/cbiptest/cbilib/cbiapi.c
/opt/SBEhw/src/cbiptest/cbilib/cbihandl.c
/opt/SBEhw/src/cbiptest/cbilib/cbiint.h
/opt/SBEhw/src/cbiptest/cbilib/cbimon.c
/opt/SBEhw/src/cbiptest/cbilib/cbioffst.c
/opt/SBEhw/src/cbiptest/cbilib/cbitrace.c
/opt/SBEhw/src/cbiptest/cbilib/sbeRelease.c
/opt/SBEhw/src/cbiptest/cbiptest/cbipmake.c
/opt/SBEhw/src/cbiptest/cbiptest/cbiprecv.c
/opt/SBEhw/src/cbiptest/cbiptest/cbipsend.c
/opt/SBEhw/src/cbiptest/cbiptest/cbiptest.c
/opt/SBEhw/src/cbiptest/cbiptest/cbiptest.h
/opt/SBEhw/src/cbiptest/cbiptest/sbeRelease.c
/opt/SBEhw/src/cbiptest/makecom
/opt/SBEhw/src/dpr_demo/Makefile
/opt/SBEhw/src/dpr_demo/dprDemo.c
/opt/SBEhw/src/dpr_demo/dprDemo.h
/opt/SBEhw/src/dpr_demo/dprMain.c
/opt/SBEhw/src/dpr_demo/makecom
/opt/SBEhw/src/dpr_demo/sbeRelease.c
/opt/SBEhw/src/echo_demo/Makefile
/opt/SBEhw/src/echo_demo/echoDemo.c
```

```
/opt/SBEhw/src/echo_demo/makecom
/opt/SBEhw/src/echo_demo/sbeRelease.c
[ verifying class <src> ]
/opt/SBEhw/bin/doadb
/opt/SBEhw/bin/wspb32
/opt/SBEhw/bin/wspb64
/opt/SBEhw/lib/adb/alloc_ctl
/opt/SBEhw/lib/adb/alloc_page
/opt/SBEhw/lib/adb/bi_q_status_s
/opt/SBEhw/lib/adb/bi_s
/opt/SBEhw/lib/adb/board_queue
/opt/SBEhw/lib/adb/commem_ctl
/opt/SBEhw/lib/adb/hmq_ctl
/opt/SBEhw/lib/adb/hmq_msg
/opt/SBEhw/lib/adb/hmqbi
/opt/SBEhw/lib/adb/host_queue
/opt/SBEhw/lib/adb/sbehw_board_prop
/opt/SBEhw/lib/adb/sbehw_hmqstats_s
/opt/SBEhw/lib/adb/sbehw_queue_prop
/opt/SBEhw/lib/adb/sparcv9/alloc_ctl
/opt/SBEhw/lib/adb/sparcv9/alloc_page
/opt/SBEhw/lib/adb/sparcv9/bi_q_status_s
/opt/SBEhw/lib/adb/sparcv9/bi_s
/opt/SBEhw/lib/adb/sparcv9/board_queue
/opt/SBEhw/lib/adb/sparcv9/commem_ctl
/opt/SBEhw/lib/adb/sparcv9/hmq_ctl
/opt/SBEhw/lib/adb/sparcv9/hmq_msg
/opt/SBEhw/lib/adb/sparcv9/hmqbi
/opt/SBEhw/lib/adb/sparcv9/host_queue
/opt/SBEhw/lib/adb/sparcv9/sbehw_board_prop
/opt/SBEhw/lib/adb/sparcv9/sbehw_hmqstats_s
/opt/SBEhw/lib/adb/sparcv9/sbehw_queue_prop
/opt/SBEhw/lib/adb/sparcv9/stage_ctl
/opt/SBEhw/lib/adb/sparcv9/wqtab
/opt/SBEhw/lib/adb/sparcv9/wspdrvstats_t
/opt/SBEhw/lib/adb/sparcv9/wspstate
/opt/SBEhw/lib/adb/stage_ctl
/opt/SBEhw/lib/adb/wqtab
/opt/SBEhw/lib/adb/wspdrvstats_t
/opt/SBEhw/lib/adb/wspstate
[ verifying class <debug> ]
## Executing postinstall script.
>> Notify RCM daemon to invoke script registration.
>> Adding HighWire entries into minor_perm file.
>> Adding HighWire entries into devlink.tab file.
>> Adding HighWire man-page sections to configuration
file.
>> Adding HighWire Device Driver into system.
/etc/rc2.d/S58hwd: Starting HighWire Master Control
Daemon.
Installation of <SBEhw> was successful.
#
HighWire #0 slot 5: HW400c/F+ entering data/signal
acquisition mode.
```

2-3-8. Sample -pkgrm- command output

```
# pkgrm SBEhw

The following package is currently installed:
   SBEhw     SBE HighWire, Solaris 8 Driver w/ MTP2 service.
             (sparcv9) REL: SOL8_HWMTP_GA_1_0

Do you want to remove this package? y

## Removing installed package instance <SBEhw>

This package contains scripts which will be executed with super-
user
permission during the process of removing this package.

Do you want to continue with the removal of this package
[y,n,?,q] y
## Verifying package dependencies.
## Processing package information.
## Executing preremove script.
>> Stopping HighWire Daemon process.
/etc/init.d/sbehwd: Stopping HighWire Master Control Daemon
(pid 412)
/etc/init.d/sbehwd: Resetting the following HighWire boards: 0.
>> Removing temporary log and socket files.
## Removing pathnames in class <debug>
/opt/SBEhw/lib/adb/wspstate
/opt/SBEhw/lib/adb/wspdrvstats_t
/opt/SBEhw/lib/adb/wqtab
/opt/SBEhw/lib/adb/stage_ctl
/opt/SBEhw/lib/adb/sparcv9/wspstate
/opt/SBEhw/lib/adb/sparcv9/wspdrvstats_t
/opt/SBEhw/lib/adb/sparcv9/wqtab
/opt/SBEhw/lib/adb/sparcv9/stage_ctl
/opt/SBEhw/lib/adb/sparcv9/sbehw_queue_prop
/opt/SBEhw/lib/adb/sparcv9/sbehw_hmqstats_s
/opt/SBEhw/lib/adb/sparcv9/sbehw_board_prop
/opt/SBEhw/lib/adb/sparcv9/host_queue
/opt/SBEhw/lib/adb/sparcv9/hmqbi
/opt/SBEhw/lib/adb/sparcv9/hmq_msg
/opt/SBEhw/lib/adb/sparcv9/hmq_ctl
/opt/SBEhw/lib/adb/sparcv9/commem_ctl
/opt/SBEhw/lib/adb/sparcv9/board_queue
/opt/SBEhw/lib/adb/sparcv9/bi_s
/opt/SBEhw/lib/adb/sparcv9/bi_q_status_s
/opt/SBEhw/lib/adb/sparcv9/alloc_page
/opt/SBEhw/lib/adb/sparcv9/alloc_ctl
/opt/SBEhw/lib/adb/sparcv9
/opt/SBEhw/lib/adb/sbehw_queue_prop
/opt/SBEhw/lib/adb/sbehw_hmqstats_s
/opt/SBEhw/lib/adb/sbehw_board_prop
/opt/SBEhw/lib/adb/host_queue
/opt/SBEhw/lib/adb/hmqbi
/opt/SBEhw/lib/adb/hmq_msg
/opt/SBEhw/lib/adb/hmq_ctl
```

```
/opt/SBEhw/lib/adb/commem_ctl
/opt/SBEhw/lib/adb/board_queue
/opt/SBEhw/lib/adb/bi_s
/opt/SBEhw/lib/adb/bi_q_status_s
/opt/SBEhw/lib/adb/alloc_page
/opt/SBEhw/lib/adb/alloc_ctl
/opt/SBEhw/lib/adb
/opt/SBEhw/bin/wspb64
/opt/SBEhw/bin/wspb32
/opt/SBEhw/bin/doadb
## Removing pathnames in class <src>
/opt/SBEhw/src/echo_demo/sbeRelease.c
/opt/SBEhw/src/echo_demo/makecom
/opt/SBEhw/src/echo_demo/echoDemo.c
/opt/SBEhw/src/echo_demo/Makefile
/opt/SBEhw/src/echo_demo
/opt/SBEhw/src/dpr_demo/sbeRelease.c
/opt/SBEhw/src/dpr_demo/makecom
/opt/SBEhw/src/dpr_demo/dprMain.c
/opt/SBEhw/src/dpr_demo/dprDemo.h
/opt/SBEhw/src/dpr_demo/dprDemo.c
/opt/SBEhw/src/dpr_demo/Makefile
/opt/SBEhw/src/dpr_demo
/opt/SBEhw/src/cbiptest/makecom
/opt/SBEhw/src/cbiptest/include
/opt/SBEhw/src/cbiptest/cbiptest/sbeRelease.c
/opt/SBEhw/src/cbiptest/cbiptest/cbiptest.h
/opt/SBEhw/src/cbiptest/cbiptest/cbiptest.c
/opt/SBEhw/src/cbiptest/cbiptest/cbipsend.c
/opt/SBEhw/src/cbiptest/cbiptest/cbiprecv.c
/opt/SBEhw/src/cbiptest/cbiptest/cbipmake.c
/opt/SBEhw/src/cbiptest/cbiptest
/opt/SBEhw/src/cbiptest/cbilib/sbeRelease.c
/opt/SBEhw/src/cbiptest/cbilib/cbitrace.c
/opt/SBEhw/src/cbiptest/cbilib/cbioffst.c
/opt/SBEhw/src/cbiptest/cbilib/cbimon.c
/opt/SBEhw/src/cbiptest/cbilib/cbiint.h
/opt/SBEhw/src/cbiptest/cbilib/cbihandl.c
/opt/SBEhw/src/cbiptest/cbilib/cbiapi.c
/opt/SBEhw/src/cbiptest/cbilib
/opt/SBEhw/src/cbiptest/Makefile.sunw
/opt/SBEhw/src/cbiptest/Makefile.gnu
/opt/SBEhw/src/cbiptest
/opt/SBEhw/src/cbi_demo/sbeRelease.c
/opt/SBEhw/src/cbi_demo/sbe/cbi/cbiDemo.h
/opt/SBEhw/src/cbi_demo/sbe/cbi
/opt/SBEhw/src/cbi_demo/sbe
/opt/SBEhw/src/cbi_demo/makecom
/opt/SBEhw/src/cbi_demo/cbiDemo.c
/opt/SBEhw/src/cbi_demo/Makefile.sunw
/opt/SBEhw/src/cbi_demo/Makefile.gnu
/opt/SBEhw/src/cbi_demo
## Removing pathnames in class <System>
/usr/share/man/sman7d/dprservice.7d
```

```
/usr/share/man/sman3sbe/sbe_dprWrite.3sbe
/usr/share/man/sman3sbe/sbe_dprRead.3sbe
/usr/share/man/sman3sbe/sbe_dprPrint.3sbe
/usr/share/man/sman3sbe/sbe_dprOpen.3sbe
/usr/share/man/sman3sbe/sbe_dprIoctl.3sbe
/usr/share/man/sman3sbe/sbe_dprHighwayReport.3sbe
/usr/share/man/sman3sbe/sbe_dprConnectionReport.3sbe
/usr/share/man/sman3sbe/sbe_dprConfigDefault.3sbe
/usr/share/man/sman3sbe/sbe_dprClose.3sbe
/usr/share/man/sman3sbe/libdpr.3sbe
/usr/share/man/sman3sbe
/usr/share/man/man7d/wsp.7d
/usr/share/man/man6/dprDemo.6
/usr/share/man/man6/cbiptest.6
/usr/share/man/man6/cbiDemo.6
/usr/share/man/man4/wspcmd.cfg.4
/usr/share/man/man4/wsp.conf.4
/usr/share/man/man3x/sbe_dataOpen.3x
/usr/share/man/man3x/sbe_ctlRcvMsg.3x
/usr/share/man/man3x/sbe_ctlOpen.3x
/usr/share/man/man3x/sbe_ctlIssueMsg.3x
/usr/share/man/man3x/sbe_ctlClose.3x
/usr/share/man/man3x/sbe_BoardReady.3x
/usr/share/man/man3/libsbe.3
/usr/share/man/man1m/wspd.1m
/usr/share/man/man1m/wspcmd.1m
/usr/share/man/man1m/hwstat.1m
/usr/share/man/man1m/hwinfo.1m
/usr/share/man/man1m/hwcmd.1m
/usr/share/man/man1m/hw_daemon.1m
/usr/share/man/man1m/highwire_rcm.1m
/usr/lib/sparcv9/libsbe.so
/usr/lib/sparcv9/libsbe.a
/usr/lib/sparcv9/libcbi.so
/usr/lib/rcm/scripts/SBEI,highwire.sh
/usr/lib/libsbe.so
/usr/lib/libsbe.a
/usr/lib/libcbi.so
/usr/include/sbe
/opt/SBEhw/src/include/stdint.h
/opt/SBEhw/src/include/sbe/wx/a0l2l3m.h
/opt/SBEhw/src/include/sbe/wx/a0l2l3d.h
/opt/SBEhw/src/include/sbe/wx
/opt/SBEhw/src/include/sbe/wspusr.h
/opt/SBEhw/src/include/sbe/wsp_que_prop.h
/opt/SBEhw/src/include/sbe/wsp_brd_prop.h
/opt/SBEhw/src/include/sbe/uppa.h
/opt/SBEhw/src/include/sbe/sbe_types.h
/opt/SBEhw/src/include/sbe/sbe_std.h
/opt/SBEhw/src/include/sbe/sbe_lib.h
/opt/SBEhw/src/include/sbe/sbe_dprlib.h
/opt/SBEhw/src/include/sbe/dprd_if.h
/opt/SBEhw/src/include/sbe/dpr/ttsi2k32t.h
/opt/SBEhw/src/include/sbe/dpr/t8102.h
```

```
/opt/SBEhw/src/include/sbe/dpr/dpr_driver.h
/opt/SBEhw/src/include/sbe/dpr/connmgr.h
/opt/SBEhw/src/include/sbe/dpr
/opt/SBEhw/src/include/sbe/ctrld_if.h
/opt/SBEhw/src/include/sbe/cbi/cbim2.h
/opt/SBEhw/src/include/sbe/cbi/cbicssif.h
/opt/SBEhw/src/include/sbe/cbi/cbi.h
/opt/SBEhw/src/include/sbe/cbi
/opt/SBEhw/src/include/sbe/bi_err.h
/opt/SBEhw/src/include/sbe
/opt/SBEhw/src/include
/opt/SBEhw/src
/opt/SBEhw/lib/sparcv9/libsbe.so
/opt/SBEhw/lib/sparcv9/libsbe.a
/opt/SBEhw/lib/sparcv9/libcbi.so
/opt/SBEhw/lib/sparcv9
/opt/SBEhw/lib/libsbe.so
/opt/SBEhw/lib/libsbe.a
/opt/SBEhw/lib/libcbi.so
/opt/SBEhw/lib
/opt/SBEhw/doc/wspd.htm
/opt/SBEhw/doc/wspcmd_cfg.htm
/opt/SBEhw/doc/wspcmd.htm
/opt/SBEhw/doc/wsp_conf.htm
/opt/SBEhw/doc/wsp.htm
/opt/SBEhw/doc/sbe_dataOpen.htm
/opt/SBEhw/doc/sbe_ctlRcvMsg.htm
/opt/SBEhw/doc/sbe_ctlOpen.htm
/opt/SBEhw/doc/sbe_ctlIssueMsg.htm
/opt/SBEhw/doc/sbe_ctlClose.htm
/opt/SBEhw/doc/sbe_BoardReady.htm
/opt/SBEhw/doc/manpages.htm
/opt/SBEhw/doc/libsbe.htm
/opt/SBEhw/doc/libdpr.htm
/opt/SBEhw/doc/hwstat.htm
/opt/SBEhw/doc/hwinfo.htm
/opt/SBEhw/doc/hwcmd.htm
/opt/SBEhw/doc/hw_daemon.htm
/opt/SBEhw/doc/highwire_rcm.htm
/opt/SBEhw/doc/dprservice.htm
/opt/SBEhw/doc/dprDemo.htm
/opt/SBEhw/doc/cbiptest.htm
/opt/SBEhw/doc/cbiDemo.htm
/opt/SBEhw/doc
/opt/SBEhw/bin/echoDemo_64
/opt/SBEhw/bin/echoDemo_32
/opt/SBEhw/bin/echoDemo
/opt/SBEhw/bin/dprDemo_64
/opt/SBEhw/bin/dprDemo_32
/opt/SBEhw/bin/dprDemo
/opt/SBEhw/bin/cbiptest_64
/opt/SBEhw/bin/cbiptest_32
/opt/SBEhw/bin/cbiptest
/opt/SBEhw/bin/cbiDemo_64
```

```
/opt/SBEhw/bin/cbiDemo_32
/opt/SBEhw/bin/cbiDemo
/opt/SBEhw <non-empty directory not removed>
/etc/rc2.d/S58hwd
/etc/rc1.d/K50hwd
/etc/rc0.d/K50hwd
/etc/init.d/sbehwd
/init.d/sbehwd
## Removing pathnames in class <Driver>
/usr/sbin/wspd
/usr/sbin/wspcmd
/usr/sbin/hwstat
/usr/sbin/hwinfo
/usr/sbin/hwcmd
/usr/sbin/hw_daemon
/usr/kernel/drv/wsp.conf
/usr/kernel/drv/wsp
/usr/kernel/drv/sparcv9/wsp
/opt/SBEhw/pdm/pdm_hwmtp.map400
/opt/SBEhw/pdm/pdm_hwmtp.hw400
/opt/SBEhw/pdm/pdm.map400
/opt/SBEhw/pdm/pdm.hw400
/opt/SBEhw/pdm
/opt/SBEhw/dev/devlink.tab.hw
/opt/SBEhw/dev
/opt/SBEhw/bin/wspd
/opt/SBEhw/bin/wspcmd
/opt/SBEhw/bin/release.sh
/opt/SBEhw/bin/hwstat
/opt/SBEhw/bin/hwinfo
/opt/SBEhw/bin/hwcmd
/opt/SBEhw/bin/hw_daemon
/opt/SBEhw/bin
/etc/opt/SBEhw/socket
/etc/opt/SBEhw/log
/etc/opt/SBEhw/cfg/wspcmd.cfg
/etc/opt/SBEhw/cfg/wspcfgfile.hw400
/etc/opt/SBEhw/cfg/wsp.conf
/etc/opt/SBEhw/cfg
/etc/opt/SBEhw
## Executing postremove script.
>> Removing HighWire man-page sections from configuration file.
>> Notify RCM daemon to remove script registration.
>> Removing HighWire Device Driver from system.
>> Removing installed directories.
>> Cleaning up HighWire entries in minor_perm file.
>> Cleaning up HighWire entries in devlink.tab file.
>> Removing HighWire devices in /dev.
## Updating system information.

Removal of <SBEhw> was successful.
```

3. Introduction to HighWire-MTP2

3-1. HW400 Boards

The HighWire family of communications boards includes the HW400c for host systems with CompactPCI interfaces and the HW400p for hosts with PCI interfaces.

Note: The HighWire 400c/R, 400c/F, and 400p also have “Plus” versions: HW400c/R+, HW400c/F+, and HW400p+. The difference between the regular and Plus versions is in the Motorola processor. The regular versions use the Motorola MPC8240; the Plus versions use the faster 8245.

3-1-1. HW400c

The HW400c is a CompactPCI (cPCI), single-slot board computer that allows a cPCI system to communicate at T1/E1 rates with other types of systems. The HW400c allows such communication to occur using SS7, transparent, or HDLC protocols.

The HW400c/R and HW400c/F cards provide identical functionality, but differ in the connectivity arrangement for the eight T1/E1 ports. For simplicity, both boards are referred to together as HW400c.

Functional Components. Each product consists of an identical base board, but other functional components vary as described in the sections below:

HW400c/R.

Base Board - An intelligent board that provides protocol and application processing on data communicated between the host and the network. Its primary components are the MPC8240 microprocessor, GlobeSpan/T.Sqware serial communication controller (SCC), and CSU/DSU functionality for eight T1/E1/J1 ports. These ports are located on a separate Rear Transition Module (RTM).

Mezzanine Board (or daughter card) - The HW400c/R Mezzanine Board contains the CSU components and magnetics to manage space considerations.

Rear Transition Module (RTM) - The HW400c/R offers eight T1/E1/J1 ports accessible through an RTM, which installs on the opposite side of the chassis from the base board. The RTM also features development and debug ports.

HW400c/F.

Base Board - An intelligent board that provides protocol and application processing on data communicated between the host and the network. Its primary components are the MPC8240 microprocessor, GlobeSpan/T.Sqware serial communication controller (SCC), and CSU/DSU functionality for eight T1/E1/J1 ports.

Mezzanine Board (or daughter card) - The HW400c/F Mezzanine Board contains the CSU components and magnetics to manage space considerations, and also contains eight T1/E1/J1 ports. The ports are arranged on the mezzanine board for front panel connectivity.

3-1-2. HW400p

The HW400p/p+ is available as a single-board or two-board set that includes these functional components:

- 2 or 6 T1/E1 physical ports
- PCI 2.1 host interface in a long card form factor
- H.100 bus interface with 32 channel Time Slot Assigner (TSA)
- Motorola 8240/8245 on-board processor
- GlobeSpan TS704 Edge Processor
- 10/100base-Tx Ethernet port
- Lucent TTSI2K32T Time Slot Interchanger (TSI)

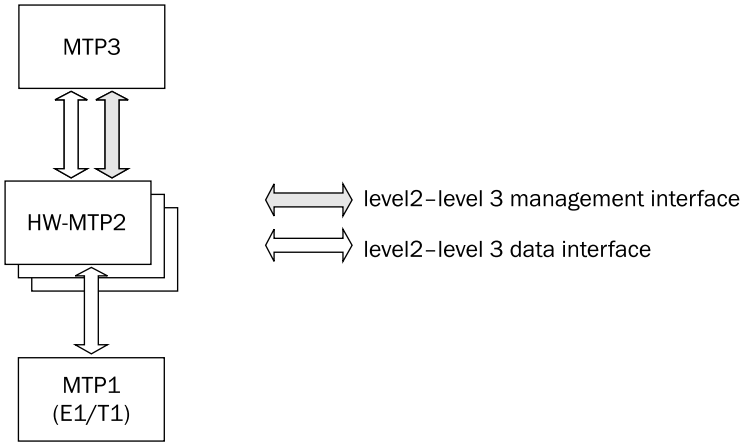
3-2. HW-MTP2 Interface Overview

The following external interfaces are present between MTP3 and HighWire MTP2 (HW-MTP2).

- HW-MTP2 Level 2 - Level 3 Management Interface
- HW-MTP2 Level 2 - Level 3 Data Interface

These interfaces are illustrated in Figure 3-1.

Figure 3-1 HW-MTP2 Level2 - Level 3 interfaces



The Level 2 - Level 3 Management and Data Interfaces are described in Chapters 5–8 of this manual.

Throughout this manual, the term “L2” will be used to refer to any Level 2 component using these interfaces (for example, HW-MTP2 or a third party product), and “L3” refers to any Level 3 component using these interfaces (for example, MTP3).

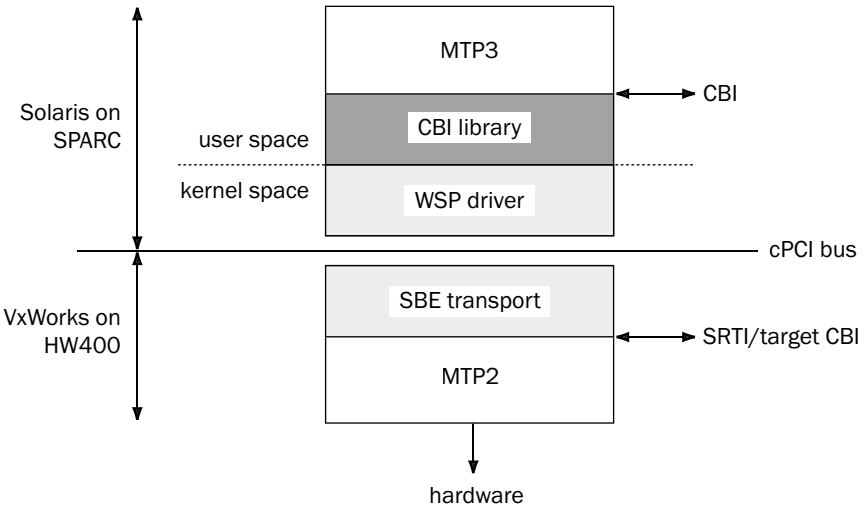
Note that each instance of HW-MTP2 can be used by only one MTP3 instance at a time. Each MTP3 instance may use multiple instances of HW-MTP2.

The signals passed over these interfaces comply with the specifications of the ITU-T recommendation and the ANSI recommendation. Any differences in the messages used between the two recommendations are indicated where relevant.

3-3. Theory of Operation

Figure 3-2 shows the interface between the host and application and the relationships of the software and hardware components.

Figure 3-2 HighWire-MTP2 theory of operation



The user communicates with the HW400 via the Cross Bus Interface (CBI) functions described in Chapter 4, *Cross Bus Interface*. HWMTP2 for SDK combines the target CBI and the MTP2 layer, excluding the SBE transport layer.

4. Cross Bus Interface

The Cross Bus Interface (CBI) is a set of functions provided to an application which allows that application to exchange messages with one or more entities on each of one or more line cards. The design of this interface accomplishes three separate aims:

- It provides a simple interface to the user.
- It is easily portable to different platforms and different underlying transport mechanisms, subject to OS support for threads.
- It is easily extendable to support new message types.

This chapter contains:

- a functional overview (Section 4-1)
- an overview of how an application should use the provided API (Section 4-2)
- a formal definition of the API calls (Section 4-3)

Chapter 6 describes the buffer formats.

4-1. Functional Overview

4-1-1. HWMTP2 for Solaris

For the purposes of this document, the system consists of five parts (see Figure 3-2):

- The CBI or cross bus interface. This interface is the message-based API provided to a user application (MTP3) running on Solaris™. The API permits the application to exchange messages with the MTP2 on the line card.
- The CBI library is a Solaris user space shared library which provides the CBI API to the application on the one hand and interfaces with STREAMS in the Solaris kernel on the other. This library is provided by SBE.
- The WSP driver resides in the Solaris kernel and routes messages between the CBI library in user space and a reliable transport layer on the line card. It makes use of the SBE BI and HMQ stack to communicate across the PCI or compact PCI bus. The WSP driver is provided by SBE.
- The reliable transport layer runs on VxWorks on the PowerPC8240 chip of the HW400 card and again makes use of the BI and HMQ stack to communicate with the streams module on the motherboard. The reliable transport is provided by SBE.
- The reliable transport interface provides a set of APIs (SRTI or SBE reliable transport interface) to allow a user application running inside VxWorks on the line card to exchange messages with an application running on the motherboard.

The system provides the following functions:

- Support for multiple MTP3 applications.
- Support for multiple HW400 cards.

4-1-2. HWMTP2 for SDK

For the purposes of this document, the system consists of two parts:

- The CBI library, embedded into the hwmtp2_for_sdk.o executable, is a VxWorks-based counterpart to the CBI library for Solaris. It provides the same message-passing interface from the target system, without the use of STREAMS.
- The MTP2 and MTP1 layers themselves, passing target-side messages to the HDLC controller.

4-2. Using the Cross Bus Interface

Basic interface functions include:

- **`cbi_initialize`**—initialize the CBI library (Section 4-2-1)
- **`cbi_terminate`**—finish with library (Section 4-2-1)
- **`cbi_open`**—open a connection to the line card (Section 4-2-2)
- **`cbi_close`**—close connection to the line card (Section 4-2-4)
- **`cbi_send`**—send message to an MTP2 instance (Section 4-2-5)
- **`cbi_recv`**—receive message from MTP2 instance on line card (Section 4-2-6)

4-2-1. Initialization and termination

Before making any other calls, an application must first initialize the library by calling **`cbi_initialize()`**. When an application has finished using the library, it must invoke **`cbi_terminate()`** before shutting down.

4-2-2. Opening and closing a connection to a line card

To send messages to and from a line card, an application must first open a connection to the line card with which it wishes to communicate. This task is accomplished with the **`cbi_open()`** call. The application provides an appl_correlator to the library, which is returned to the application by all library callback functions and allows the application to identify the line card associated with those callbacks. The application supplies the cbi_correlator returned by **`cbi_open()`** as a parameter to all subsequent calls to the library. When an application no longer wishes to communicate with a specific line card, it invokes **`cbi_close()`**.

4-2-3. Opening and closing a sub-interface

The CBI interface acts as a reliable transport over which different interfaces may be multiplexed. Within the context of this document, a set of Inter-Process Signal (IPS) messages composing a single SBE product interface (for example the interface to MTP2) is referred to as a sub-interface. Each sub-interface is described in its own header file.

4-2-4. Connecting to and disconnecting from an MTP2 instance

When an application wishes to communicate with an MTP2, it must first open a connection to the line card where the MTP2 will be located (as explained in Section 4-2-3). It must then open the MTP2 sub-interface (defined in the header file cbim2.h) by sending a CBI_M2_OPEN message. Once the application has received a CBI_M2_OPEN response, it may send one or more CBI_M2_REGISTER messages (one for each MTP2 with which it wishes to communicate). Details of how to send a message are provided Section 4-2-5. The MTP3 should fill in the sender_handle field of the CBI_IPS substructure with a correlator of its own choosing. Subsequent messages received across the interface will always contain this value in the receiver_handle field of the CBI_IPS substructure, which is always the first member of any control buffer structure. The MTP3 must wait for a CBI_M2_REGISTER response (after which it must be able to receive messages) and a CBI_M2_AVAILABLE (after which the MTP3 is free to send other MTP2 messages as it wishes according to the SS7-defined protocol).

Disconnection may be initiated by either the MTP3 or the MTP2. The MTP2 instance will only initiate disconnection in the event of an unexpected hardware or software failure.

Table 4-1 Sequence of events in disconnections

Cause of disconnection	Sequence of events
Intended disconnection	MTP3 sends a CBI_M2_UNREGISTER message to an MTP2 and awaits a CBI_M2_UNREGISTER response.
MTP2 failure	MTP3 receives a CBI_M2_UNAVAILABLE message from the library. Upon receipt of a CBI_M2_UNAVAILABLE message, the MTP3 application must respond with a CBI_M2_UNREGISTER message. Unregistration proceeds as normal.
Total failure (hardware or software) of connection to line card	MTP3 receives an error code M2_RC_IO_ERROR to a call to **`cbi_send()`** or **`cbi_recv()`**. MTP3 then takes all necessary steps to reopen the connection to the line card, reopen the sub-interface, and reregister with all the MTP2 instances.

4-2-5. Sending messages to MTP2

To send a message to MTP2, the MTP3 implementation must set up all the fields in a control buffer using the appropriate structure defined in the header file. MTP3 is free to use whatever sort of memory it likes (stack or otherwise) for this buffer except that the memory must be flat. The buffer must be longer than the defined structure by the amount returned on the CBI_M2_OPEN response in the send_ctrl_tail_size field. If there is an associated data

component for the message (CBI_M2_MSG_FOR_XMISSION), then a data buffer must also be supplied. The data buffer is subject to the same constraints as the control buffer, except that the additional space must be provided both at the start and the tail of the data, and the amounts of empty space provided are determined by the send_data_hdr_size and send_data_tail_size fields of the CBI_M2_OPEN response.

The MTP3 then invokes the **`cbi_send()`** API to dispatch the message. The **`cbi_send()`** API may either complete synchronously and return CBI_RC_SYNC_COMPLETE or asynchronously complete and return CBI_RC_ASYNC_COMPLETE. If asynchronous completion is indicated, the application is responsible for re-transmitting the message when resources become available.

4-2-6. Receiving messages from MTP2

Once **`cbi_open()`** has been successfully called, an application is notified of arriving messages via the CBI_MSG_AVAIL_CALLBACK. The CBI library invokes this callback on a separate thread of execution. The application must then immediately issue the **`cbi_recv()`** call to receive the message (the application may issue this call on the same thread as it receives the callback if it so desires, or it may issue it on an alternative thread). The **`cbi_recv()`** call may complete with the CBI_RC_SYNC_COMPLETE return code, in which case the message has been fully received into the application's buffer. Alternatively, the **`cbi_recv()`** call may complete with the CBI_RC_ASYNC_COMPLETE return code, in which case the message was not completely available. In this later case, the buffers do not contain a complete message. The same buffers must be passed back into **`cbi_recv()`** the next time the CBI library signals the application again with the CBI_MSG_AVAIL_CALLBACK when more of the message becomes available. In this case, the application must not alter, re-use, or free such buffers. The CBI library may also return CBI_RC_NO_MSG, in which case the message was destined for the library itself (in this case, however, the buffers are returned to the application which may reuse or free them as it sees fit). Note that the application is responsible for providing any header and/or tail bytes that it requires.

4-2-7. Send-side flow control (HWMTP2 for Solaris only)

When the application invokes **`cbi_send()`**, the library will normally be able to complete the send operation synchronously and return the CBI_RC_SYNC_COMPLETE return code. In this case, the application may free or re-use the buffers which contained the message.

If, on the other hand, the library is unable to send a complete message (instead sending only part or none of the message) it returns CBI_RC_ASYNC_COMPLETE. In this case the application must re-transmit the flow controlled message once resources become available for cross bus transfer.

This library-messaging mechanism allows the application (or layers above it) to impose flow control by allocating their buffers from a fixed size pool. When messages cannot be dispatched across the interface, the number of available buffers shrinks since the application may not free them back to the pool until they have been sent. When the pool contains no further available buffers, the application cannot send any more data.

Send-side flow control applies to both control and data messages in exactly the same way.

4-2-8. Receive-side flow control

Receive-side flow control is not an integral part of the CBI interface; rather, it is managed by IPS signals as part of the CBI_M2 sub-interface.

Receive-side flow control is simpler than send-side flow control as far as the application is concerned. The underlying MTP2 has a fixed size buffer pool for data messages, and messages sent to the MTP3 implementation continue to count against the pool limit until the MTP3 informs the MTP2 that they no longer need to be counted in this manner.

Therefore the MTP3 (or higher layers) must make a conscious decision about when it no longer wishes a particular message to count against the MTP2 buffer pool limit. The MTP3 should then send a CBI_M2_CREDIT message across the interface. Note that it is obviously inefficient to send one credit message in response to every received message, so the message definition allows MTP3 to wait until it has finished with a number of received messages and then send just one credit message down to MTP2 granting multiple credits. It is left to the application (which originally set the size of MTP2's buffer pool on the CBI_M2_UPDATE_PARMS message) to determine a suitable interval for sending such messages, which should be a small fraction of the size of the buffer pool itself.

4-3. Basic Interface Functions and API Calls

4-3-1. cbi_initialize

Prototype.

```
CBI_UINT32 cbi_initialize(
    CBI_SENT_CALLBACK * sent_cb,
    CBI_MSG_AVAIL_CALLBACK * msg_avail_cb)
```

Description. This function is invoked by the user to initialize the library. It must be invoked before any other calls are made.

Parameters

sent_cb	This callback has been deprecated [null] for Highwire MTP2 for Solaris GA 1.0. This value is **null** for HWMTP2 for SDK, since all messages are guaranteed to be delivered to the stack.
msg_avail_cb	The address of the message available callback routine that the application supplies to allow the library to notify it when a message is available to be received.

Returns. CBI_RC_SYNC_COMPLETE if the library has been successfully initialized. Any other return code indicates an error.

4-3-2. cbi_terminate

Prototype.

void cbi_terminate(void)

Description. This function is invoked by the user to terminate the library. It must be invoked when the application does not wish to make any further calls across the interface.

Parameters. None.

Returns. void.

4-3-3. cbi_open

Prototype.

```
CBI_UINT32 cbi_open(
    const char *name,
    CBI_CORR * cbi_correlator,
    CBI_CORR appl_correlator)
```

Description. This function is invoked by MTP3 to obtain a correlator for subsequent communications to a line card. Note that a single correlator is obtained once and is valid for any and all MTP2 instances that are eventually created on the card.

Parameters.

name	The driver name. This parameter uniquely identifies a line card. Its value is the path of the streams device corresponding to the card in question. For example, HW0_MTP2_0 is HighWire board 0. This value is **null** for HWMTP2 for SDK, since no Streams device exists.
cbi_correlator	The dress of the correlator that the application must supply on all subsequent calls to the interface when addressing the line card identified by the name parameter. Returned parameter.
appl_correlator	The correlator that the application uses to identify the line card indicated by the name parameter. The CBI library supplies this correlator to the application on all callbacks associated with this line card.

Returns. CB_RC_SYNC_COMPLETE if the call is successful. Otherwise, an error code indicating that the device does not exist, no correlators are available, or the stream cannot be opened.

4-3-4. cbi_close

Prototype.

```
CBI_UINT32 cbi_close(
    CBI_CORR cbi_correlator)
```

Description. This function is used to signal the driver that no further messages will be transferred in either direction to the line card which is identified by the cbi_correlator.

Parameters.

cbi_correlator	The correlator returned by the **cbi_open()** call.

Returns. CBI_RC_SYNC_COMPLETE if the driver has successfully processed the **`cbi_close()`**. Otherwise, a specific error code.

4-3-5. cbi_recv

Prototype.

```
CBI_UINT32 cbi_recv(
    CBI_CORR cbi_correlator,
    char * ctrl_buf,
    CBI_BUF_SIZE ctrl_len,
    char * data_buf,
    CBI_BUF_SIZE data_len)
```

Description. This routine gets a message from the library if one is available. This call does not block. The application must supply the buffers for receiving the message and is responsible for freeing those buffers when it has finished with the message.

Parameters.

cbi_correlator	The correlator that identifies the device from which to read.
ctrl_buf	A pointer to a supplied buffer which will contain the control portion of any message upon return.
ctrl_len	The length of the supplied control buffer.
data_buf	A pointer to a supplied buffer which will contain the data portion of any message upon return. Note that the length of the data in the data buffer is determined by the data_len field in the CBI_PKT_HDR structure, which is always present in the control buffer for messages with an associated data component.
data_len	The length of the supplied data buffer.

Returns.

- CBI_RC_SYNC_COMPLETE if a message was successfully obtained.
- CBI_RC_ASYNC_COMPLETE if only part of a message was available. In this case, the buffers returned to the application contain only a partial message and should not be used. The next time the library signals that another message is available, the same buffers should be passed back to the library and the remainder of the message will be filled in.
- CBI_RC_NO_MSG if no message was available for the user (i.e. the message was destined for the library itself).
- CBI_RC_INVALID if an invalid correlator was specified.

4-3-6. cbi_send

Prototype.

```
CBI_UINT32 cbi_send(
    CBI_CORR cbi_correlator,
    char * ctrl_buf,
    char * data_buf)
```

Description. This routine supplies a message to the library for dispatch to a line card. This call does not block.

Parameters.

cbi_correlator	The correlator identifying the line card for which the message is destined.
ctrl_buf	A pointer to a control buffer. Note that the length of the control buffer is determined by the ctrl_size field in the CBI_IPS structure which is always present in the control buffer for messages with an associated data component.
data_buf	A pointer to a data buffer. Note that the length and offset of the data in the data buffer are determined by the data_len and data_start fields in the CBI_PKT_HDR structure, which is always present in the control buffer for messages with an associated data component.

Returns.

- CBI_RC_SYNC_COMPLETE if the message was sent in a synchronous fashion.
- CBI_RC_ASYNC_COMPLETE indicates that the message has not been completely sent due to a flow control condition; the user must re-transmit any flow controlled message once resources become availabe for cross bus transfer.
- CBI_RC_IO_ERROR indicates that there is a problem with the communication pipeline to the line card and that the user must close and reopen the connection to reestablish communication.
- CBI_RC_INVALID indicates that the supplied correlator is invalid.

4-3-7. CBI_MSG_AVAIL_CALLBACK

Prototype.

```
typedef int CBI_MSG_AVAIL_CALLBACK(
    CBI_CORR appl_correlator,
    CBI_LONG ips_type,
    CBI_BUF_SIZE ctrl_len,
    CBI_BUF_SIZE data_len)
```

Description. This routine informs the user application that a message is available to be received. The user should immediately issue a **cbi_recv()** to receive the message. This callback is invoked on a separate thread of execution created by the library so the application should make sure that any data accessed within the context of this callback is locked appropriately.

Parameters.

appl_correlator	The correlator used by the application to identify the line card associated with this callback.
Ips_type	The type of message that the application will receive when it next issues **cbi_recv()**.
ctrl_len	The minimum length of the control buffer that the application should provide on the subsequent **cbi_recv()**.
data_len	The minimum length of the data buffer that the application should provide on the subsequent **cbi_recv()**.

Returns. Not used.

5. HW-MTP2 Level 2 - Level 3 Interfaces and Message Flows

5-1. Level 2 - Level 3 Management Interface

The Level 2 - Level 3 Management Interface allows an L3 component to manage the operation of an L2 component.

This interface allows:

- registration and unregistration of L3 with the management interface
- control and reporting of the link state
- control over the link proving mode
- local and remote processor outage
- support for link changeover
- notification of link congestion
- gathering of static and dynamic information
- monitoring of events detected by L2

This interface contains the following structures:

- CBI_M2_AVAILABLE
- CBI_M2_BSNT
- CBI_M2_BSNT_NOT_RETRIEVABL
- CBI_M2_CLEAR_RTB
- CBI_M2_CONTINUE
- CBI_M2_EMERGENCY
- CBI_M2_EMERGENCY_CEASES
- CBI_M2_EV_INDICATION
- CBI_M2_EV_REGISTER
- CBI_M2_EV_UNREGISTER
- CBI_M2_FLUSH_BUFFERS
- CBI_M2_IN_SERVICE
- CBI_M2_LINK_CONGESTED
- CBI_M2_LINK_CONGSTN_CEASED
- CBI_M2_LOC_PROCSSR_OUTAGE
- CBI_M2_LOC_PROCSSR_RECOVRD
- CBI_M2_REGISTER
- CBI_M2_UNREGISTER
- CBI_M2_OUT_OF_SERVICE
- CBI_M2_QUERY_CONFIG

- CBI_M2_QUERY_STATS
- CBI_M2_QUERY_STATUS
- CBI_M2_RB_CLEARED
- CBI_M2_REM_PROCSSR_OUTAGE
- CBI_M2_REM_PROCSSR_RECOVRD
- CBI_M2_RETRIEVAL_COMPLETE
- CBI_M2_RETRIEVAL_NOT_POSS
- CBI_M2_RETRIEVED_MESSAGE
- CBI_M2_RETRIEVE_BSNT
- CBI_M2_RTB_CLEARED
- CBI_M2_START
- CBI_M2_STOP
- CBI_M2_UNAVAILABLE
- CBI_M2_UPDATE_PARMS

These structures are defined in the header file **cbim2.h** and described in more detail in Chapter 6, *CBI Buffer Formats*.

5-2. Level 2 - Level 3 Data Interface

The Level 2 - Level 3 Data Interface defines the data transfer and control interface between an L2 and an L3.

This interface allows:

- registration and unregistration of L2 with the data interface
- transmission and receipt of normal data packets
- requests for the retrieval of data packets which have not been successfully transmitted.

This interface contains the following structures:

- CBI_M2_MSG_FOR_XMISSION
- CBI_M2_RECEIVED_MESSAGE
- CBI_M2_RETRIEVAL_REQ_FSNC
- CBI_M2_CLOSE
- CBI_M2_CREDIT
- CBI_M2_CREDIT_ERROR
- CBI_M2_OPEN

These structures are defined in the header file **cbim2.h** and described in more detail in Chapter 6, *CBI Buffer Formats*.

5-3. Message Flows

The L3 uses the Level 2 - Level 3 Interfaces to register with as many instances of L2 as it requires, to activate and deactivate links, to access and respond to status information, and to send and receive data.

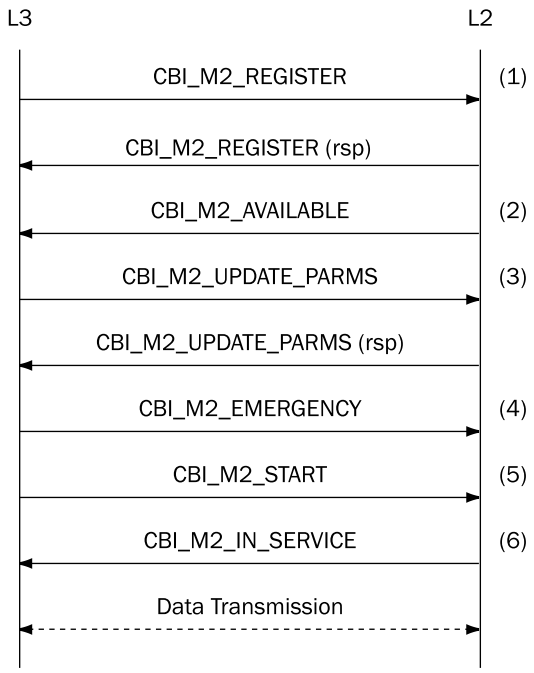
This section describes typical flows that the L3 can use. This section is not intended to be a full set of signal flows; other flows of signals are possible, and some signals are not included. The signal structures are described in detail in Chapter 6, *CBI Buffer Formats*.

The following abbreviations are used in the message flow diagrams for the components of the stack:

L2	Level 2 component (for example, HW-MTP2)
L3	Level 3 component (for example, MTP3)

5-3-1. Link activation

Figure 5-1 Message flows involved in registering with an L2 process and activating a link.

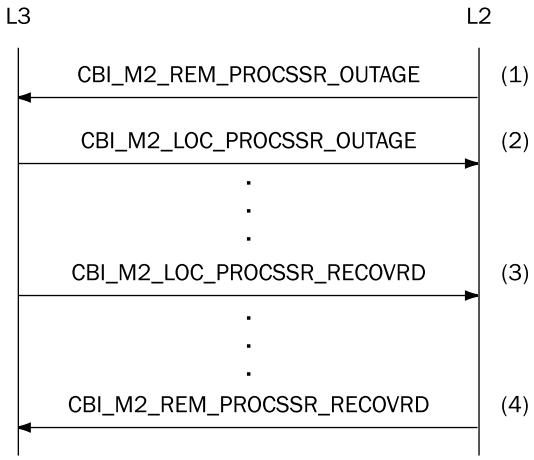


1. L3 sends a CBI_M2_REGISTER to L2 to identify the correct MTP3 process with which L2 should communicate. L2 responds to the request indicating whether the L2 stack initialized successfully.
2. L2 sends a CBI_M2_AVAILABLE to notify the L3 that it has opened the data interface and is ready to receive further signals.
3. L3 then optionally sends a CBI_M2_UPDATE_PARMS to define the dynamically changeable parameters in L2. L2 returns the signal as a response, indicating if the update was successful. If CBI_M2_UPDATE_PARMS is not issued, the parameters take their default values.
4. L3 may or may not send a CBI_M2_EMERGENCY signal to request that L2 perform emergency link proving. This signaling involves exchanging only a limited set of data proving signals with the peer L2 process to accelerate the alignment process.
5. L3 sends a CBI_M2_START signal to request that a link be established. This action initiates the alignment process.
6. L2 sends a CBI_M2_IN_SERVICE to L3 when the link proving phase has completed successfully. L3 may now transmit and receive data packets.

5-3-2. Remote Processor Outage (RPO)

RPO with ITU-T national option LPO to RPO latching.

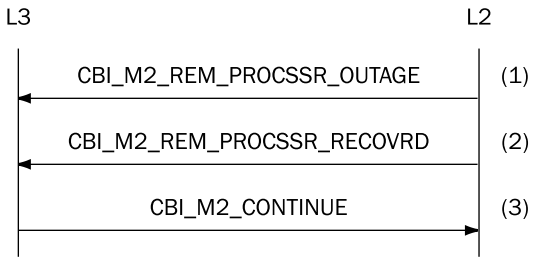
Figure 5-2 Message flows involved when the remote end of the link suffers a processor outage.



1. L2 issues a CBI_M2_REM_PROCSSR_OUTAGE to L3 to indicate that the remote end of the link is signalling a processor outage condition.
2. L3 sends a CBI_M2_LOC_PROCSSR_OUTAGE to L2 and starts the changeover for the link. Neither the BSNT nor messages are retrieved.
3. When the changeover is complete, L3 sends a CBI_M2_LOC_PROCSSR_RECOVRD to L2.
4. At some later time, L2 sends a CBI_M2_REM_PROCESSR_RECOVRD to notify L3 that the remote end of the link has indicated that a processor outage condition has ended.

RPO with ITU-T or ANSI changeover in progress on recovery.

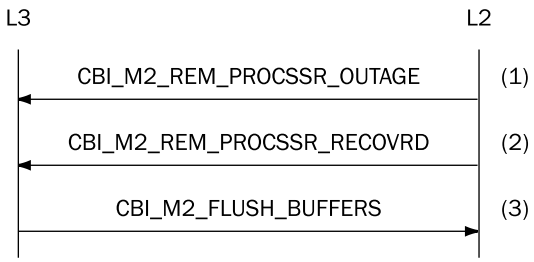
Figure 5-3 Message flows involved when the remote end of the link suffers a processor outage.



1. L2 issues a CBI_M2_REM_PROCSSR_OUTAGE to L3 to indicate that the remote end of the link is signalling a processor outage condition.
2. L2 sends a CBI_M2_REM_PROCESSR_RECOVRD to notify L3 that the remote end of the link has indicated that a processor outage condition has ended.
3. L3 sends the CBI_M2_CONTINUE signal to indicate to L2 that normal communication has resumed and requests that L2 resume sending data messages to its peer L2 process, including any messages pending transmission before the processor outage condition occurred.

RPO with ITU-T changeover complete on recovery.

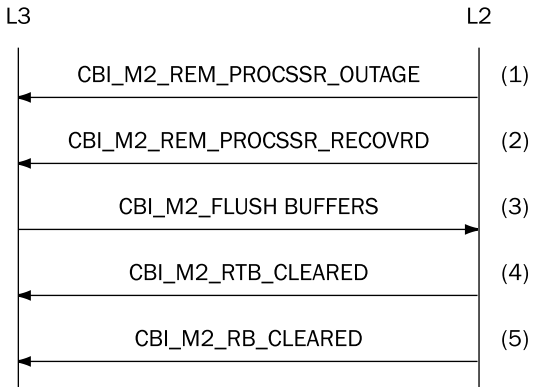
Figure 5-4 Message flows involved when the remote end of the link suffers a processor outage.



1. L2 issues a CBI_M2_REM_PROCSSR_OUTAGE to L3 to indicate that the remote end of the link is signalling a processor outage condition.
2. L2 sends a CBI_M2_REM_PROCESSR_RECOVRD to notify L3 that the remote end of the link has indicated that a processor outage condition has ended.
3. L3 sends the CBI_M2_FLUSH_BUFFERS signal to request that L2 discard any data messages pending transmission before the processor outage condition occurred, and then resume sending data messages to its peer L2 process.

RPO with ANSI changeover complete on recovery.

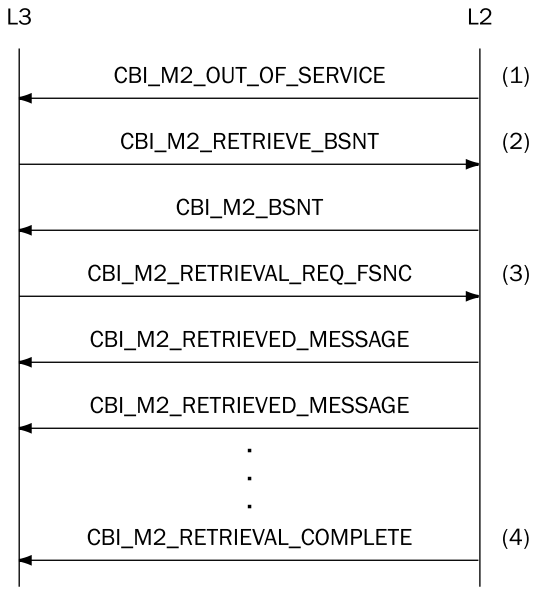
Figure 5-5 Message flows involved when the remote end of the link suffers a processor outage.



1. L2 issues a CBI_M2_REM_PROCSSR_OUTAGE to L3 to indicate that the remote end of the link is signalling a processor outage condition.
2. L2 sends a CBI_M2_REM_PROCESSR_RECOVRD to notify L3 that the remote end of the link has indicated that a processor outage condition has ended.
3. L3 sends the CBI_M2_FLUSH_BUFFERS signal to instruct L2 to discard all data messages in its retransmission buffer, transmission buffer, and receive buffer.
4. When it has cleared the retransmission buffer, L2 sends a CBI_M2_RTB_CLEARED signal to L3.
5. When it has cleared the receive buffer, L2 sends a CBI_M2_RB_CLEARED signal to L3.

5-3-3. Changeover following local detection of link failure

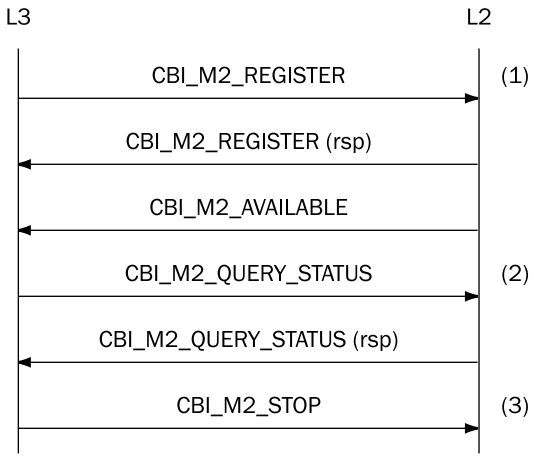
Figure 5-6 Message flows involved when L2 detects that a link has failed.



1. When L2 detects that the link has become unusable, it sends a CBI_M2_OUT_OF_SERVICE signal to inform L3.
2. L3 then issues a CBI_M2_RETRIEVE_BSNT signal to request that L2 process all PDUs received from the remote L2 so far and then send a CBI_M2_BSNT signal back to L3. The CBI_M2_BSNT signal contains the sequence number of the last received message. If the sequence number could not be obtained, L2 sends back a CBI_M2_BSNT_NOT_RETRIEVABL signal.
3. L3 then sends a CBI_M2_RETRIEVAL_REQ_FSNC signal to request that L2 return all messages that L3 has passed to it for transmission but which have not yet been acknowledged by the partner. L2 returns the messages in CBI_M2_RETRIEVED_MESSAGE signals.
4. When all unacknowledged messages have been returned, L2 sends a CBI_M2_RETRIEVAL_COMPLETE signal to L3. (Even if L2 does not send any CBI_M2_RETRIEVED_MESSAGE signals, it must return the CBI_M2_RETRIEVAL_COMPLETE signal to L3.) If the retrieval of unacknowledged messages is not possible, L2 sends a CBI_M2_RETRIEVAL_NOT_POSS signal to indicate this situation to L3.

5-3-4. Failover of MTP3 Control Part

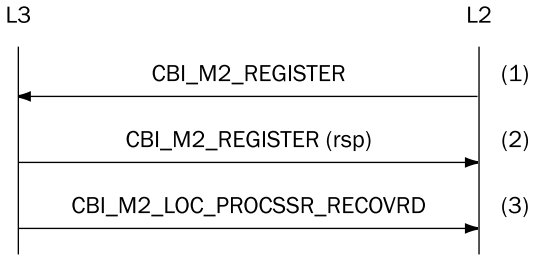
Figure 5-7 Message flows involved after failover of the control part of MTP3 has occurred.



1. L3 sends a CBI_M2_REGISTER to L2 to identify the new MTP3 process with which L2 should communicate. L2 returns the signal as a response indicating whether the registration was successful. L2 also sends a CBI_M2_AVAILABLE to notify the L3 that a data interface registration is in place, and that it is ready to receive further signals.
2. On receipt of the CBI_M2_REGISTER response, L3 sends a CBI_M2_QUERY_STATUS signal to L2 to request link status information. L2 returns its current status information in a CBI_M2_QUERY_STATUS response.
3. If the status information held by L3 does not match that received from L2, L3 is responsible for synchronizing the two processes. In this situation, L3 issues a CBI_M2_STOP signal to L2 to release the link with the peer L2 process.

5-3-5. MTP3 Data Part failure

Figure 5-8 Message flows involved when the data part of MTP3 fails and is immediately replaced.

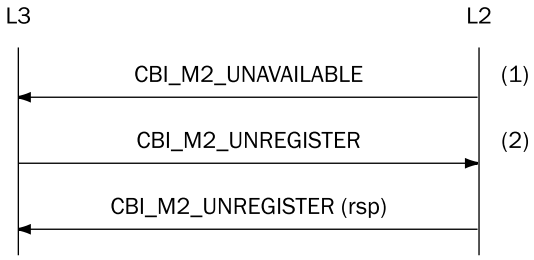


When L2 is informed of the failure of the MTP3 Data Part, it behaves as if it had received a Local Processor Outage signal from MTP3.

1. When L2 is informed of the replacement MTP3 Data Part, it sends a CBI_M2_REGISTER to L3 to register with the new MTP3 data process.
2. L3 returns the signal as a response indicating whether the registration was successful. If the registration was successful, further messages can flow on the data interface in both directions.
3. L3 sends a CBI_M2_LOC_PROCSSR_RECOVRD to L2 to fully activate the link again.

5-3-6. MTP3 Data Part unavailability

Figure 5-9 Message flows involved when the data part of MTP3 fails and is not immediately replaced.



1. L2 sends a CBI_M2_UNAVAILABLE to notify L3 that the join to the L2-L3 data interface has permanently failed.
2. When L3 receives this signal, it issues a CBI_M2_UNREGISTER to dissociate the L3 from the L2. L2 returns the signal as a response.

6. CBI Buffer Formats

The header files cbi.h and cbim2.h contains all the structures that define the format of information within the control buffers passed between the user application and the library in the ctrl_buffer parameter of the cbi_send and cbi_recv calls. Note that both control and data buffers consist of contiguous memory, and that control buffers of messages which possess data parts contain fields indicating the offset of the start of any data within its buffer and the length of the data.

6-1. Common Header Sub-Structures

6-1-1. CBI_M2_COMMON_PARMS

This structure contains L2 common configuration parameters.

Data structure.

```
typedef struct cbi_m2_common_parms
{
  CBI_ULONG     cong_method;
  CBI_BYTE      num_cong_levels;
  CBI_ULONG     cong_onset[CBI_M2_MAX_NUM_CONG_LEVELS + 1];
  CBI_ULONG     cong_abate[CBI_M2_MAX_NUM_CONG_LEVELS + 1];
  CBI_ULONG     cong_discard[CBI_M2_MAX_NUM_CONG_LEVELS + 1];
  CBI_ULONG     t_tx_dur;
  CBI_ULONG     t_ty_dur;
  CBI_BYTE      initial_status;
  CBI_ULONG     rcv_pool_capacity;
} CBI_M2_COMMON_PARMS;
```

Parameters.

cong_method

The type of transmission congestion control employed by the L2. This field can take the following values:

CBI_CONG_CTRL_ INTERNATIONAL	Single congestion onset/abatement thresholds. Single discard threshold.
CBI_CONG_CTRL_ NATL_WITH_PRI	Multiple (3) onset/abatement thresholds with multiple (3) discard thresholds for discarding messages based on priority.
CBI_CONG_CTRL_ NATL_TIMER	Multiple states for congestion. One discard threshold. Changes to the state are determined by a single onset threshold and the continuous length of time the transmitter remains above that threshold.
CBI_CONG_CTRL_ NATL_BUFFER	Multiple (3) onset/abatement thresholds. One discard threshold.

num_cong_levels
The number of levels (other than zero) used for transmission congestion control.

If **cong_method** is CBI_CONG_CTRL_NATL_WITH_PRI or CBI_CONG_CTRL_NATL_BUFFER, this field denotes how many entries are valid in the **cong_onset**, **cong_abate,** and possibly **cong_discard** arrays. The comments on those fields assume a value of 3, for clarity.

If **cong_method** is CBI_CONG_CTRL_NATL_TIMER, this field denotes the number of congestion states allowed.

If **cong_method** is CBI_CONG_CTRL_INTERNATIONAL, this field is ignored.

The maximum value is 3.

cong_onset
Transmission congestion onset thresholds. At the end of this list of parameters is a section, entitled “Transmission congestion onset and abatement thresholds”, which provides more detail on the usage of this parameter.

cong_abate
Transmission congestion abatement thresholds. At the end of this list of parameters is a section, entitled “Transmission congestion onset and abatement thresholds”, which provides more detail on the usage of this parameter.

cong_discard
Congestion discard thresholds. At the end of this list of parameters is a section, entitled “Transmission congestion discard thresholds”, which provides more detail on the usage of this parameter.

The following fields (**t_tx_dur**, **t_ty_dur,** and **initial_status**) are only valid if **cong_method** is CBI_CONG_CTRL_NATL_TIMER.

t_tx_dur
Timer Tx. If the number of messages queued on L2’s transmit and retransmit queues exceeds the transmission congestion onset threshold for the duration of timer Tx, the congestion status increments by 1 (up to its limit). The units of this field are milliseconds.

t_ty_dur
Timer Ty. If the number of messages queued on L2’s transmit and retransmit queues is lower than the transmission congestion abatement threshold for the duration of timer Ty, the congestion status decrements by 1 (down to its limit). The units of this field are milliseconds.

initial_status
The initial value assigned to the transmission congestion state when the current congestion level is 0 and the number of queued messages first exceeds the congestion onset threshold. This value must be less than the value of **num_cong_levels**. Note that the timer Tx is not used in this instance.

rcv_pool_capacity
The capacity of the buffer pool used to receive messages from the partner level 2.

Transmission congestion onset and abatement thresholds.

If **cong_method** is CBI_CONG_CTRL_NATL_WITH_PRI or CBI_CONG_CTRL_NATL_BUFFER, the valid array indexes are 1 to **num_cong_levels**, representing the respective onset and abatement thresholds.

- When the number of messages queued in L2's transmit and retransmit queues exceeds congestion onset threshold N, L2 sends an M2_LINK_CONGESTED signal to L3 indicating a level of congestion equal to N.
- When the number of queued messages falls below congestion abatement threshold M, L2 sends an M2_LINK_CONGESTED signal to L3 indicating a level of congestion equal to (M - 1).
- If a change in the number of messages queued causes the congestion level to jump over more than one threshold, only one M2_LINK_CONGESTED signal is sent. If the congestion is rising, the congestion parameter of the M2_LINK_CONGESTED signal carries the level of the largest onset threshold which is less than the current queue size. If the congestion is falling, the congestion parameter carries the level of the smallest abatement threshold that is greater than the current queue size.
- The level N congestion abatement threshold must be greater than the level (N-1) onset threshold.

If **cong_method** is CBI_CONG_CTRL_INTERNATIONAL, the valid array index is 0.

- When the number of messages queued in L2's transmit and retransmit queues exceeds the congestion onset threshold, L2 sends an M2_LINK_CONGESTED signal to L3 indicating a level of congestion of 1.
- When the queue length falls below the congestion abatement threshold, L2 sends an M2_LINK_CONGSTN_CEASED signal to L3.

If **cong_method** is CBI_CONG_CTRL_NATL_TIMER, the valid array index is 0.

- See comments on **t_tx_dur** and **t_ty_dur** for how the onset and abatement thresholds are used.
- When the congestion level changes, an M2_LINK_CONGESTED signal is sent to L3.

Transmission congestion discard thresholds.

The array index 0 is always valid. It is the absolute discard threshold. When the number of messages queued in L2's transmit and retransmit queues exceeds the absolute discard threshold, L2 always discards all new messages from L3, irrespective of the value of **cong_method**. The absolute discard threshold must be set such that if **cong_method** is set to CBI_CONG_CTRL_INTERNATIONAL, the onset of congestion occurs before the absolute discard threshold is reached. For other values of **cong_method**, the highest congestion level must be reached before the absolute discard threshold is reached. If the absolute discard threshold is set to zero, new messages should never be discarded.

If **cong_method** is CBI_CONG_CTRL_NATL_WITH_PRI, the array indexes 1 to **num_cong_levels** are also valid, representing discard thresholds 1 to **num_cong_levels** respectively.

- When the number of messages queued in L2's transmit and retransmit queues exceeds congestion discard threshold N (N = 1, 2, or 3), L2 discards messages from L3 which have a message priority less than N.
- Congestion discard threshold N must be greater than congestion onset threshold N and less than onset threshold (N+1).
- Congestion discard threshold **num_cong_levels** must be less than the absolute discard threshold described above.
- A value of 0 indicates never discard the message.

6-1-2. CBI_M2_MTP2_PARMS

This structure contains MTP2-specific configuration parameters.

Data structure.

```
typedef struct cbi_m2_mtp2_parms
{
  CBI_M2_MTP2_TIMER_PARMS     timers;
  CBI_M2_MTP2_RCV_CONG_PARMS  rcv_congestion;
  CBI_M2_MTP2_LINK_PARMS      link_parms;
  CBI_ULONG                   max_proving_attempts;
  CBI_M2_MTP2_AERM_PARMS      aerm;
  CBI_ULONG                   in_service_monitor;
  CBI_M2_MTP2_SUERM_PARMS     suerm;
  CBI_M2_MTP2_EIM_PARMS       eim;
} CBI_M2_MTP2_PARMS;
```

Substructures.

```
typedef struct cbi_m2_mtp2_aerm_parms
{
  CBI_ULONG     aerm_tin;
  CBI_ULONG     aerm_tie;
  CBI_ULONG     aerm_n;
} CBI_M2_MTP2_AERM_PARMS;

typedef struct cbi_m2_mtp2_eim_parms
{
```

```
  CBI_ULONG     eim_te;
  CBI_ULONG     eim_t8;
  CBI_ULONG     eim_ue;
  CBI_ULONG     eim_de;
} CBI_M2_MTP2_EIM_PARMS;

typedef struct cbi_m2_mtp2_link_parms
{
  CBI_LONG      error_correction_method;
  CBI_ULONG     transmission_rate;
  CBI_ULONG     loop_delay;
  CBI_ULONG     sequence_num_bits;
  CBI_ULONG     send_msu_window;
  CBI_ULONG     send_octet_window;
  CBI_ULONG     rcv_msu_window;
} CBI_M2_MTP2_LINK_PARMS;

typedef struct cbi_m2_mtp2_rcv_cong_parms
{
  CBI_ULONG     onset;
  CBI_ULONG     abate;
} CBI_M2_MTP2_RCV_CONG_PARMS;

typedef struct cbi_m2_mtp2_suerm_parms
{
  CBI_ULONG     suerm_t;
  CBI_ULONG     suerm_d;
  CBI_ULONG     suerm_n;
} CBI_M2_MTP2_SUERM_PARMS;

typedef struct cbi_m2_mtp2_timer_parms
{
  CBI_ULONG     t_t1_dur;
  CBI_ULONG     t_t2_dur;
  CBI_ULONG     t_t3_dur;
  CBI_ULONG     t_t4n_dur;
  CBI_ULONG     t_t4e_dur;
  CBI_ULONG     t_t5_dur;
  CBI_ULONG     t_t6_dur;
  CBI_ULONG     t_t7_dur;
} CBI_M2_MTP2_TIMER_PARMS;
```

Parameters.

timers MTP2 timer parameters.

timers.**t_t1_dur**
Q.703 T1 timer. Time, in milliseconds, to remain in aligned ready state while waiting for the remote L2 to reach aligned ready. If the remote L2 does not reach aligned ready by this time, the link activation is failed.

timers.**t_t2_dur**
Q.703 T2 timer. Total time, in milliseconds, that the L2 attempts link alignment. If the link has still not aligned by this time, the link activation is failed.

timers.**t_t3_dur**
Q.703 T3 timer. Total time, in milliseconds, that the L2 remains aligned before starting proving while waiting for the remote L2 to also become aligned. If the remote L2 does not become aligned by this time, the link activation is failed.

timers.**t_t4n_dur**
Q.703 T4 timer for normal proving. Total time, in milliseconds, for the proving period.

timers.**t_t4e_dur**
Q.703 T4 timer for emergency proving. Total time, in milliseconds, for the proving period.

timers.**t_t5_dur**
Q.703 T5 timer. Total time, in milliseconds, between sending successive SIB signal units to the remote L2 when this L2 is suffering from receiving congestion.

timers.**t_t6_dur**
Q.703 T6 timer. Maximum time, in milliseconds, for which a remote L2 can refuse to accept message signal units due to congestion before the L2 declares the link failed.

timers.**t_t7_dur**
Q.703 T7 timer. Maximum time, in milliseconds, between new MSU acknowledgments from the remote L2. In periods of receive congestion, it becomes the maximum time between reception of SIB signal units while a remote L2 is refusing to accept message signal units due to congestion before the L2 declares the link failed.

rcv_congestion MTP2 receive congestion parameters.

rcv_congestion.**onset**
Receive congestion onset threshold. If the number of MSUs in the reception buffer gets bigger than this value, level 2 flow control measures begin.

rcv_congestion.**abate**
Receive congestion abatement threshold. If the number of MSUs in the reception buffer falls below this value, level 2 flow control measures end (if in operation).

link_parms MTP2 link parameters.

link_parms.**error_correction_method**
Specifies the error correction method to be used. This field can take the following values:

- CBI_ERR_METHOD_BASIC
- CBI_ERR_METHOD_PCR

link_parms.**transmission_rate**
Specifies the transmission rate of the link (in bits/second) and implies the transmission type (56 and 64 kbits, or faster imply digital; 4.8 kbits implies analog). Note that CBI_XMIT_RATE_MBITS1_5 is used to denote 1.5 Mbit/s for ITU and 1.536 Mbit/s for ANSI. This field can take the following values:

- CBI_XMIT_RATE_KBITS4P8
- CBI_XMIT_RATE_KBITS56
- CBI_XMIT_RATE_KBITS64
- CBI_XMIT_RATE_MBITS1_5
- CBI_XMIT_RATE_MBITS2_0

link_parms.**loop_delay**
Loop delay. The time, in milliseconds, between the sending of a message signal unit and the reception of the acknowledgement for that message signal unit in normal operation.

link_parms.**sequence_num_bits**
Number of bits in sequence number. The maximum FSN and BSN values in an SU are one less than two to the power of this parameter.

link_parms.**send_msu_window**
Maximum number of outgoing MSUs available for retransmission. This value is used by both the BER and PCR error correction methods. In the PCR case, it corresponds to the Q703 N1 parameter. A value of zero means that there is no maximum (other than the constraint imposed by the available FSN values).

link_parms.**send_octet_window**
Maximum number of outgoing octets available for retransmission. This value is used by both the BER and PCR error correction methods. In the PCR case, it corresponds to the Q703 N2 parameter. A value of zero means that there is no maximum.

link_parms.**rcv_msu_window**
Maximum number of unprocessed incoming MSUs that may be held by the underlying device at any one time.

max_proving_attempts
Maximum number of failed proving attempts before the link returns to the Out of Service state. This is the Q703 AERM M parameter.

aerm
Alignment Error Rate Monitor (AERM) parameters (used during proving).

aerm.**aerm_tin**
Q703 AERM Tin parameter. Normal-mode threshold of the (AERM) counter.

aerm.**aerm_tie**
Q703 AERM Tie parameter. Emergency-mode threshold of the (AERM) counter.

aerm.**aerm_n**
Q703 AERM N parameter. The number of octets that causes an increment of the AERM counter while in “octet counting” mode.

in_service_monitor
Type of monitor to use while in the In Service state. Typically this value is the SUERM for lower speed links and the EIM for higher speed links. This field can take the following values:

CBI_IN_SERVICE_SUERM
This value instructs the L2 to use the SUERM as its In Service error monitor.

CBI_IN_SERVICE_EIM
This value instructs the L2 to use the EIM as its In Service error monitor.

suerm
Signal Unit Error Rate Monitor (SUERM) parameters. Ignored if the EIM is the configured In Service monitor.

suerm.**suerm_t**
Q703 SUERM T parameter. Threshold of the SUERM counter.

suerm.**suerm_d**
Q703 SUERM D parameter. Number of octets received for each decrement of the SUERM counter.

suerm.**suerm_n**
Q703 SUERM N parameter. The number of octets that causes an increment of the SUERM counter while in “octet counting” mode.

eim
Errored Interval Monitor (EIM) parameters. Ignored if the SUERM is the configured In Service monitor.

eim.**eim_te**
Q703 EIM TE parameter. Threshold of the EIM counter.

eim.**eim_t8**
Q703 EIM T8 parameter. Monitoring interval, in milliseconds, between each adjustment of the EIM counter.

eim.**eim_ue**
Q703 EIM UE parameter. Increment of the EIM counter after each interval in which an error occurred

eim.**eim_de**
Q703 EIM DE parameter. Decrement of the EIM counter after each interval in which no error occurred.

6-1-3. CBI_M2_SAAL_PARMS

This structure is not used in MTP2 implementations and should be zeroed.

6-1-4. CBI_PKT_HDR

This structure is a header for all messages which include control and data parts.

Data structure.

```
typedef struct cbi_pkt_hdr
{
   CBI_ULONG data_start;
   CBI_ULONG data_len;
}
```

Parameters.

data_start

offset to the beginning of the data in the packet part of the IPS. This offset allows reserved header space to be left at the beginning of the packet.

data_len

Length of the data. This value refers to the length of the actual data itself, not including the length of any requested header of tail bytes.

6-2. CBI Message Summary

The Level 2 - Level 3 Interface provides a set of structures for the different messages passed between level 3 and level 2 when they do not reside in the same N-BASE. This interface is intended primarily for use by third party MTP3 implementations but may also be used by an MTP3 to communicate with an HW-MTP2 residing at a separate location when there is no distributed N-BASE present.

6-2-1. Signals sent from L3 to L2

The following structures are sent from the L3 to the L2.

CBI_M2_REGISTER	Identifies the associated L3 process.
CBI_M2_UNREGISTER	Disconnects L2 from the sending L3 process and, for SAAL, disconnects it from the ATM network.
CBI_M2_UPDATE_PARMS	Supplies dynamically changeable configuration parameters to L2.
CBI_M2_QUERY_CONFIG	Retrieves static configuration information from L2.

CBI_M2_QUERY_STATS	Retrieves dynamic statistical information from L2.
CBI_M2_QUERY_STATUS	Retrieves processing status information from L2.
CBI_M2_EV_REGISTER	Directs L2 to send event notifications.
CBI_M2_EV_UNREGISTER	Directs L2 to stop sending notifications.
CBI_M2_LOC_PROCSSR_OUTAGE	Notifies L2 that the L3 component has experienced a processor outage.
CBI_M2_LOC_PROCSSR_RECOVRD	Notifies L2 that the L3 component has recovered from a processor outage.
CBI_M2_EMERGENCY	Requests Emergency link proving mode.
CBI_M2_EMERGENCY_CEASES	Requests Normal link proving mode.
CBI_M2_STOP	Deactivates a link.
CBI_M2_START	Requests activation of a link.
CBI_M2_FLUSH_BUFFERS	Directs the L2 to clear its transmission and retransmission buffers by discarding any messages currently in them.
CBI_M2_CLEAR_RTB	Directs the L2 to clear its retransmission buffer by discarding any messages currently in it.
CBI_M2_CONTINUE	Directs the L2 to continue normal operation after a local or remote processor outage.
CBI_M2_RETRIEVE_BSNT	Requests return of the latest received BSNT value. Either a CBI_M2_BSNT or CBI_M2_BSNT_NOT_RETRIEVABL signal is sent in response.
CBI_M2_MSG_FOR_XMISSION	Used by the L3 to send data.
CBI_M2_RETRIEVAL_REQ_FSNC	Requests retrieval of non-acknowledged messages issued by the L3. The response to this signal is a sequence of CBI_M2_RETRIEVED_MESSAGE messages finishing with a CBI_M2_RETRIEVAL_COMPLETE message.
CBI_M2_OPEN	L3 sends this message to L2 during initialization immediately after issuing the **cbi_open()** call. It opens a connection to the line card. L2 returns the signal as a response.
CBI_M2_CLOSE	L3 sends this message to L2 at the end of all processing to close a connection to a line card. It should be issued before the calls to **cbi_close()** and **cbi_terminate()**.
CBI_M2_CREDIT	L3 sends this message to L2 to release buffers for flow control purposes on the line card. It is used to inform the L2 how many messages have been completely processed, since the last credit message was sent. L2 will release that number of buffers back into its buffer pool. Hence, the L3 must ensure that it sends this message with sufficient frequency to avoid the L2 buffer pool emptying.

6-2-2. Signals sent from L2 to L3

The following signals are sent from L2 to the L3. Note that some of these signals are event indications, and are only sent if the L3 has registered for receipt of them with the CBI_M2_EV_REGISTER request.

CBI_M2_AVAILABLE	Notifies the L3 that L2 initialization is complete and that the L2 is available to send messages.
CBI_M2_UNAVAILABLE	Notifies the L3 that the L2 is now unavailable to send messages. The only message that the L3 may send to the L2 after receipt of this message is a CBI_M2_MGMT_UNREGISTER.
CBI_M2_EV_INDICATION	L2 notifies the L3 of the occurrence of an event for which it has registered.
CBI_M2_LINK_CONGESTED	Indicates that the transmitter is congested.
CBI_M2_LINK_CONGSTN_CEASED	Indicates that the transmitter is no longer congested.
CBI_M2_IN_SERVICE	Indicates the link is available for data transmission.
CBI_M2_OUT_OF_SERVICE	Indicates the link is not available for data transmission.
CBI_M2_RETRIEVED_MESSAGE	Returns non-acknowledged, retrieved messages to the L3. This signal is sent in response to a CBI_M2_RETRIEVAL_REQ_FSNC message.
CBI_M2_RETRIEVAL_COMPLETE	Indicates that retrieval of non-acknowledged messages is complete. This is the final signal in the sequence of messages sent in response to a CBI_M2_RETRIEVAL_REQ_FSNC message.
CBI_M2_RETRIEVAL_NOT_POSS	Indicates that retrieval of non-acknowledged messages is not possible. No further messages are sent in response to a CBI_M2_RETRIEVAL_REQ_FSNC message.
CBI_M2_BSNT	Returns the BSNT value. This signal is sent in response to a CBI_M2_RETRIEVE_BSNT signal.
CBI_M2_BSNT_NOT_RETRIEVABL	Notifies the L3 that the BSNT cannot be retrieved. This signal is sent in response to a CBI_M2_RETRIEVE_BSNT signal.

CBI_M2_REM_ PROCSSR_OUTAGE	Notifies the L3 that the remote end of the link is signaling a processor outage condition.
CBI_M2_REM_ PROCSSR_RECOVRD	Notifies the L3 that the remote end of the link has signaled that a processor outage condition has ended.
CBI_M2_RB_CLEARED	Notifies the L3 that the receive buffer has been cleared, as requested by the L3. ANSI only.
CBI_M2_RTB_CLEARED	Notifies the L3 that the retransmission buffer has been cleared, as requested by the L3. ANSI only.
CBI_M2_RECEIVED_ MESSAGE	Used to send a received data message to the L3.
CBI_M2_CREDIT_ERROR	This message is sent by L2 to L3 to inform the application that it has sent an invalid credit message.

6-3. CBI Messages: Detailed Description

Note: The CBI messages are listed in alphabetical order.

6-3-1. CBI_M2_AVAILABLE

L2 sends this signal to the L3 at some point after responding to a CBI_M2_REGISTER to notify the L3 that the L2 has completed the join to the L2-L3 Data Interface and is available to receive further signals. Until the L3 has received this signal, the only signal that it may send to the L2 is a CBI_M2_UNREGISTER.

There is no response to this message.

Data structure.

```
typedef struct cbi_m2_available
{
  CBI_IPS       ips_hdr;
} CBI_M2_AVAILABLE;
```

Parameters.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_AVAILABLE.

sender_handle - L2's handle for the join for this link.

receiver_handle - L3's handle for the join for this link.

6-3-2. CBI_M2_BSNT

L2 sends this message to the L3 in response to a CBI_M2_RETRIEVE_BSNT request to pass the sequence number of the last received message. There is no response to this message.

Data structure.

```
typedef struct cbi_m2_bsnt
{
  CBI_IPS       ips_hdr;
  CBI_ULONG     bsnt;
} CBI_M2_BSNT;
```

Parameters.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_BSNT.

sender_handle - L2's handle for the join for this link.

receiver_handle - L3's handle for the join for this link.

bsnt
This is the sequence number of the last received PDU. It can take values in the range 0 to 2^24 - 1.

6-3-3. CBI_M2_BSNT_NOT_RETRIEVABL

L2 sends this message to the L3 in response to a CBI_M2_RETRIEVE_BSNT request if it cannot retrieve the sequence number of the last received message.

There is no response to this message.

Data structure.

```
typedef struct cbi_m2_bsnt_not_retrievabl
{
  CBI_IPS       ips_hdr;
} CBI_M2_BSNT_NOT_RETRIEVABL;
```

Parameters.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_BSNT_NOT_RETRIEVABL.

sender_handle - L2's handle for the join for this link.

receiver_handle - L3's handle for the join for this link.

6-3-4. CBI_M2_CLEAR_RTB

The L3 sends this message to L2 to request that it discard all data messages in its retransmission buffer. This request is issued while in a processor outage state.

If the major version of L2 is AWSFI, L2 sends a CBI_M2_RTB_CLEARED message in response to this message once it clears its retransmission buffer.

Data structure.

```
typedef struct cbi_m2_clear_rtb
{
  CBI_IPS       ips_hdr;
} CBI_M2_CLEAR_RTB;
```

Parameters.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_CLEAR_RTB.

sender_handle - L3's handle for the join for this link.

receiver_handle - L2's handle for the join for this link.

6-3-5. CBI_M2_CLOSE

L3 sends this message to L2 at the end of all processing to close a connection to a line card. It should be issued before the calls **`cbi_close()`** and **`cbi_terminate()`**.

Data structure.

```
typedef struct cbi_m2_close
{
  CBI_IPS ips_hdr;
} CBI_M2_CLOSE;
```

Parameters.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_CLOSE

sender_handle - not valid

receiver_handle - not valid

6-3-6. CBI_M2_CONTINUE

The L3 sends this message to L2 following a processor outage to request that it resume sending data messages to its peer L2 process, including sending any messages pending transmission before the processor outage occurred.

This message is referred to as “resume” in the ANSI version of the MTP2 specification.

There is no response to this message.

Data structure.

```
typedef struct cbi_m2_continue
{
  CBI_IPS       ips_hdr;
} CBI_M2_CONTINUE;
```

Parameters.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_CONTINUE.

sender_handle - L3’s handle for the join for this link.

receiver_handle - L2’s handle for the join for this link.

6-3-7. CBI_M2_CREDIT

L3 sends this message to L2 to inform L2 that L3 has completed processing a number of received messages. This message allows L2 to release buffers back to the MTP2 buffer pool and acts as receive-side flow control.

L3 must ensure that it sends the CBI_M2_CREDIT message to L2 with sufficient frequency to avoid emptying the MTP2 buffer pool.

There is no response to this message unless the number of buffers specified is larger than the number of buffers received (see Section 6-3-8, “CBI_M2_CREDIT_ERROR”).

Data structure.

```
typedef struct cbi_m2_credit
{
  CBI_IPS ips_hdr;
  CBI_ULONG num_msgs;
} CBI_M2_CREDIT;
```

Parameters.

ips_hdr

IPS header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_CREDIT.

sender_handle - L3’s handle for the join for this link.

receiver_handle - L2’s handle for the join for this link.

num_msgs

This field informs L2 how many messages have been completely processed since the last credit message was sent. It is the number of buffers to be released back to the buffer pool.

6-3-8. CBI_M2_CREDIT_ERROR

This message is sent by L2 to L3 to inform the application that it has sent an invalid credit message.

Note: This message is not intended for normal operation. It is intended to be used as an aid to L3 development/integration in that it will be sent to the L3 when the L3 has attempted to grant credit for messages it has not received. If the L2 receives an invalid CBI_M2_CREDIT message (num_msgs is too large), it will send a CBI_M2_CREDIT_ERROR message back to the L3. Therefore, an L3 under development should assert immediately upon receiving a CBI_M2_CREDIT_ERROR message.

Data structure.

```
typedef struct cbi_m2_credit_error
{
  CBI_IPS ips_hdr;
  CBI_ULONG num_msgs;
} CBI_M2_CREDIT_ERROR;
```

Parameters.

ips_hdr
IPS header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_CREDIT_ERROR.

sender_handle - L3's handle for the join for this link.

receiver_handle - L2's handle for the join for this link.

num_msgs
Not used.

6-3-9. CBI_M2_EMERGENCY

The L3 sends this message to L2 to request that it perform emergency link proving. This process involves exchanging a limited set of data proving signals with the peer L2 process.

There is no response to this signal.

Data structure.

```
typedef struct cbi_m2_emergency
{
  CBI_IPS       ips_hdr;
} CBI_M2_EMERGENCY;
```

Parameters.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_EMERGENCY.

sender_handle - L3's handle for the join for this link.

receiver_handle - L2's handle for the join for this link.

6-3-10. CBI_M2_EMERGENCY_CEASES

The L3 sends this message to L2 to request that it return to normal link proving. This process involves exchanging the full set of data proving signals with the peer L2 process.

There is no response to this signal.

Data structure.

```
typedef struct cbi_m2_emergency_ceases
{
  CBI_IPS       ips_hdr;
} CBI_M2_EMERGENCY_CEASES;
```

Parameters.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_EMERGENCY_CEASES.

sender_handle - L3's handle for the join for this link.

receiver_handle - L2's handle for the join for this link.

6-3-11. CBI_M2_EV_INDICATION

L2 sends this signal to L3 to indicate that an event has occurred for which the L3 has registered. L3 does not return a response to this signal.

Data structure.

```
typedef struct cbi_m2_ev_indication
{
  CBI_IPS       ips_hdr;
  CBI_ULONG     type;
  CBI_ULONG     time_stamp;
  CBI_BYTE      status;
  CBI_BYTE      proving_mode;
} CBI_M2_EV_INDICATION;
```

Parameters.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_EV_INDICATION.

sender_handle - L2's handle for the join for this link.

receiver_handle - L3's handle for the join for this link.

type

The type of the event indication; one of the following values:

CBI_M2_EV_LINK_STATUS	Changes in link status.
CBI_M2_EV_SL_FAIL_ALL	Link failure - all reasons.
CBI_M2_EV_SL_FAIL_FIBR_BSNR	Link failure - abnormal FIBR/BSNR.
CBI_M2_EV_SL_FAIL_NO_RSP	Link failure because the partner L2 process failed to respond within the required time.
CBI_M2_EV_SL_FAIL_ERROR_RATE	Link failure because the Error Monitor has failed the link.
CBI_M2_EV_SL_FAIL_CONG_DELAY	Link failure because L2 has been without send credit for longer than the allowed period.
CBI_M2_EV_CONG_WITH_DISCARD_1	The first message has been discarded at discard level 1 after moving to this level.
CBI_M2_EV_CONG_WITH_DISCARD_2	The first message has been discarded at discard level 2 after moving to this level.
CBI_M2_EV_CONG_WITH_DISCARD_3	The first message has been discarded at discard level 3 after moving to this level.
CBI_M2_EV_ALL_EVENTS	Any of the events listed above have occurred.

time_stamp

The time stamp of the indication. It is the elapsed time in 1/100 second from the system start time of L2.

status

The status of the link. This field is only valid if the type field has the value CBI_M2_EV_LINK_STATUS. It can take the following values:

CBI_M2_LINK_OUT_OF_SERVICE	No connection to partner L2.
CBI_M2_LINK_ALIGNING	L2 is establishing a connection.
CBI_M2_LINK_PROVING	A connection has been established and link proving is in progress.
CBI_M2_LINK_ALIGNED	Local L2 has successfully proved the link and is awaiting proving confirmation from the partner.
CBI_M2_LINK_IN_SERVICE	Local and remote L2 processes have successfully proved the link and data transfer may now take place.

proving_mode
The proving mode in use by L2. This field is only valid if the **type** field has the value CBI_M2_EV_LINK_STATUS and the **status** field has the value CBI_M2_LINK_PROVING, CBI_M2_LINK_ALIGNED, or CBI_M2_LINK_IN_SERVICE. This field can take the following values:

CBI_M2_PS_PROVING_UNKNOWN	L2 has not yet started link proving.
CBI_M2_PS_PROVING_NORMAL	L2 is performing Normal link proving.
CBI_M2_PS_PROVING_EMERGENCY	L2 is performing Emergency link proving.

6-3-12. CBI_M2_EV_REGISTER

L3 sends this signal to L2 to register to receive notification of specific events and state changes in the L2. Subsequent CBI_M2_EV_REGISTER signals add to existing registrations.

L2 returns the signal as a response.

If a CBI_M2_EV_REGISTER is outstanding in the L2 when the L3 fails over, the request should be processed to completion, but the response should be discarded.

Data structure.

```
typedef struct cbi_m2_ev_register
{
  CBI_IPS       ips_hdr;
  CBI_ULONG     return_code;
  CBI_ULONG     event_code;
} CBI_M2_EV_REGISTER;
```

Parameters on request.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_EV_REGISTER.

sender_handle - L3's handle for the join for this link.

receiver_handle - L2's handle for the join for this link.

return_code - see "Parameters on response"

event_code
Flags for the events for which L3 is requesting notification. This field can take a combination of the values, combined using a bitwise OR. Values for indication types are:

CBI_M2_EV_LINK_STATUS	Changes in link status.
CBI_M2_EV_SL_FAIL_ALL	Link failure - all reasons.
CBI_M2_EV_SL_FAIL_FIBR_BSNR	Link failure - abnormal FIBR/BSNR.
CBI_M2_EV_SL_FAIL_NO_RSP	Link failure because the partner L2 process failed to respond within the required time.
CBI_M2_EV_SL_FAIL_ERROR_RATE	Link failure because the Error Monitor has failed the link.
CBI_M2_EV_SL_FAIL_CONG_DELAY	Link failure because L2 has been without send credit for longer than the allowed period.
CBI_M2_EV_CONG_WITH_DISCARD_1	The first message has been discarded at discard level 1 after moving to this level.
CBI_M2_EV_CONG_WITH_DISCARD_2	The first message has been discarded at discard level 2 after moving to this level.
CBI_M2_EV_CONG_WITH_DISCARD_3	The first message has been discarded at discard level 3 after moving to this level.
CBI_M2_EV_ALL_EVENTS	Any of the events listed above have occurred.

Parameters on response.

ips_hdr
IPS Header. For definition, see Section 6-1-1. Handles from request are swapped.

return_code
Return code indicating whether the registration was successful. This field can take the following values:

CBI_OK	The registration to receive notification of the events specified in **event_code** was successful.
CBI_RESOURCE_FAILURE	The registration failed because the L2 could not obtain the required resources (for example, because of a memory shortage).
CBI_UNSUCCESSFUL	The registration failed for a reason other than resource shortage.

6-3-13. CBI_M2_EV_UNREGISTER

L3 sends this signal to L2 to unregister previous registrations for event notification. L2 returns the signal as a response.

Data structure.

```
typedef struct cbi_m2_ev_unregister
{
  CBI_IPS       ips_hdr;
  CBI_ULONG     event_code;
} CBI_M2_EV_UNREGISTER;
```

Parameters on request.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_EV_UNREGISTER.

sender_handle - L3's handle for the join for this link.

receiver_handle - L2's handle for the join for this link.

event_code
Flags for the events for which External Management no longer requires notification. This field can take a combination of the values, combined using a bitwise OR. Values for indication types are:

CBI_M2_EV_LINK_STATUS	Changes in link status.
CBI_M2_EV_SL_FAIL_ALL	Link failure - all reasons.
CBI_M2_EV_SL_FAIL_FIBR_BSNR	Link failure - abnormal FIBR/BSNR.
CBI_M2_EV_SL_FAIL_NO_RSP	Link failure because the partner L2 process failed to respond within the required time.
CBI_M2_EV_SL_FAIL_ERROR_RATE	Link failure because the Error Monitor has failed the link.
CBI_M2_EV_SL_FAIL_CONG_DELAY	Link failure because L2 has been without send credit for longer than the allowed period.
CBI_M2_EV_CONG_WITH_DISCARD_1	The first message has been discarded at discard level 1 after moving to this level.
CBI_M2_EV_CONG_WITH_DISCARD_2	The first message has been discarded at discard level 2 after moving to this level.
CBI_M2_EV_CONG_WITH_DISCARD_3	The first message has been discarded at discard level 3 after moving to this level.
CBI_M2_EV_ALL_EVENTS	Any of the events listed above have occurred.

Parameters on response.

ips_hdr
IPS Header. For definition, see Section 6-1-1. Handles from request are swapped.

6-3-14. CBI_M2_FLUSH_BUFFERS

The L3 sends this message to L2 following a processor outage to request that it discard any data messages pending transmission before the processor outage occurred, and resume sending data messages to its peer L2 process.

This message is referred to as “clear buffers” in the ANSI version of the MTP2 spec.

There is no response to this message if the major version of the L2 is ITU.

If the major version of the L2 is ANSI, the L2 sends a CBI_M2_RTB_CLEARED message when it has cleared the retransmission buffer, and a CBI_M2_RB_CLEARED message when it has cleared the receive buffer. These two response messages may be sent in either order.

Data structure.

```
typedef struct cbi_m2_flush_buffers
{
  CBI_IPS       ips_hdr;
} CBI_M2_FLUSH_BUFFERS;
```

Parameters.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_FLUSH_BUFFERS.

sender_handle - L3’s handle for the join for this link.

receiver_handle - L2’s handle for the join for this link.

6-3-15. CBI_M2_IN_SERVICE

L2 sends this message to the L3 when the link proving phase has completed successfully. The L3 may now transmit data packets.

There is no response to this message.

Data structure.

```
typedef struct cbi_m2_in_service
{
  CBI_IPS       ips_hdr;
} CBI_M2_IN_SERVICE;
```

Parameters.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_IN_SERVICE.

sender_handle - L2's handle for the join for this link.

receiver_handle - L3's handle for the join for this link.

6-3-16. CBI_M2_LINK_CONGESTED

L2 sends this message to the L3 to indicate congestion at some lower layer. After receiving a CBI_M2_LINK_CONGESTED signal, the L3 should reduce the rate of sending data to the L2 until it receives a CBI_M2_LINK_CONGSTN_CEASED signal for the link.

There is no response to this message.

For multiple congestion level configuration, L2 sends just CBI_M2_LINK_CONGESTED signals with the appropriate level of congestion. The L3 then decides how to change the rate at which it sends data messages to L2.

For single congestion level support, L2 alternates sending CBI_M2_LINK_CONGESTED and CBI_M2_LINK_CONGSTN_CEASED signals.

Data structure.

```
typedef struct cbi_m2_link_congested
{
  CBI_IPS       ips_hdr;
  CBI_BYTE      cong_level;
} CBI_M2_LINK_CONGESTED;
```

Parameters.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_LINK_CONGESTED.

sender_handle - L2's handle for the join for this link.

receiver_handle - L3's handle for the join for this link.

cong_level
This is the current congestion level when multiple congestion levels have been configured. Constants for the congestion level in use by L2. This field can take the following values:

- CBI_M2_CONG_LEVEL_1
- CBI_M2_CONG_LEVEL_2
- CBI_M2_CONG_LEVEL_3
- CBI_M2_CONG_NONE

6-3-17. CBI_M2_LINK_CONGSTN_CEASED

L2 sends this message to the L3 when a congestion condition in the lower layers (previously reported with the CBI_M2_LINK_CONGESTED signal) is cleared. The L3 can start increasing the rate of sending data again.

There is no response to this message.

Data structure.

```
typedef struct cbi_m2_link_congstn_ceased
{
  CBI_IPS       ips_hdr;
} CBI_M2_LINK_CONGSTN_CEASED;
```

Parameters.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_LINK_CONGESTN_CEASED.

sender_handle - L2's handle for the join for this link.

receiver_handle - L3's handle for the join for this link.

6-3-18. CBI_M2_LOC_PROCSSR_OUTAGE

The L3 sends this signal to L2 to notify it that the L3 process has experienced a processor outage.

There is no response to this signal.

Data structure.

```
typedef struct cbi_m2_loc_procssr_outage
{
  CBI_IPS       ips_hdr;
} CBI_M2_LOC_PROCSSR_OUTAGE;
```

Parameters.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_LOC_PROCSSR_OUTAGE.

sender_handle - L3's handle for the join for this link.

receiver_handle - L2's handle for the join for this link.

6-3-19. CBI_M2_LOC_PROCSSR_RECOVRD

The L3 sends this signal to L2 to notify L2 that the L3 process has recovered from a processor outage.

There is no response to this signal.

Data structure.

```
typedef struct cbi_m2_loc_procssr_recovrd
{
  CBI_IPS       ips_hdr;
} CBI_M2_LOC_PROCSSR_RECOVRD;
```

Parameters.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_LOC_PROCSSR_RECOVRD.

sender_handle - L3's handle for the join for this link.

receiver_handle - L2's handle for the join for this link.

6-3-20. CBI_M2_REGISTER

The L3 sends this signal to the L2 to register as a user of the link. Once the registration response is received, the L3 must be capable of receiving other messages across the interface. The L3 may not transmit messages across the interface until a CBI_M2_AVAILABLE has been received.

The L2 returns the signal as a response.

Note that once this message has been sent, the application may not send **ANY** further messages (even a CBI_M2_UNREGISTER) until it has received the CBI_M2_REGISTER and CBI_M2_AVAILABLE response.

Data structure.

```
typedef struct cbi_m2_register
{
  CBI_IPS                       ips_hdr;
  CBI_ULONG                     return_code;
  CBI_PROC_ID                   l3_mgmt_pid;
  CBI_QUEUE_ID                  l3_mgmt_qid;
  CBI_ULONG                     link_set_id;
  CBI_BYTE                      link_slc;
  CBI_ULONG                     l3_id;
  CBI_ULONG                     major_variant;
  CBI_M2_MTP2_REGISTER_PARMS    mtp2_parms;
  CBI_M2_SAAL_REGISTER_PARMS    saal_parms;
} CBI_M2_REGISTER;
```

Parameters on request.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_REGISTER.

sender_handle - L3's handle for the join for this link.

receiver_handle - L2's handle for the join for this link.

l3_mgmt_pid
Process ID to which L2 must send all management messages for this L3, including the CBI_M2_REGISTER response.

l3_mgmt_qid
Queue ID to which L2 must send all management messages for this L3, including the CBI_M2_REGISTER response.

The following fields (**link_set_id**, **link_slc,** and **l3_id**) are used for logging in L2 and are supplied by L3 on the CBI_M2_REGISTER signal to facilitate coordinated logging across the SS7 system. L2 does not interpret these values, but just supplies them on the Problem Determination Logs.

link_set_id
ID of the Link Set to which this L2 link belongs. L3 supplies this field for logging purposes only.

link_slc
The Signalling Link Code of this link. L3 supplies this field for logging purposes only.

l3_id
An identifier for the specific L3 process using this link. L3 supplies this field for logging purposes only.

major_variant
Major variant option. This field can take the following values:

CBI_M2_MAJOR_VARIANT_ITU	Major variant is ITU.
CBI_M2_MAJOR_VARIANT_ANSI	Major variant is ANSI.

mtp2_parms
See Section 6-1-2.

saal_parms
This structure is not used in MTP2 implementations and should be zeroed.

Parameters on response.

ips_hdr
IPS Header. For definition, see Section 6-1-1. Handles from request are swapped.

return_code
Return code from L2 to L3 indicating whether the L2 stack initialized successfully. This field can take the following values:

CBI_OK	The stack was initialized successfully.
CBI_UNSUCCESSFUL	The stack was not initialized.

6-3-21. CBI_M2_UNREGISTER

The L3 sends this signal to L2 to dissociate the L3 from the L2 process. If the L2 has a join to the L2-L3 Data Interface of the L3, it must delete it on receipt of this signal (although it does not need to wait for that join to finish being removed before replying to this signal).

The L2 returns the signal as a response.

This signal always succeeds.

Data structure.

```
typedef struct cbi_m2_unregister
{
  CBI_IPS       ips_hdr;
} CBI_M2_UNREGISTER;
```

Parameters on request.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_UNREGISTER.

sender_handle - L3's handle for the join for this link.

receiver_handle - L2's handle for the join for this link.

Parameters on response.

ips_hdr
IPS Header. For definition, see Section 6-1-1. Handles from request are swapped.

6-3-22. CBI_M2_MSG_FOR_XMISSION

The L3 sends this message to the L2 to pass it a data message to be sent over the link.

There is no response to this message.

Data structure.

```
typedef struct cbi_m2_msg_for_xmission
{
  CBI_IPS       ips_hdr;
  CBI_PKT_HDR   pkt_hdr;
  CBI_ULONG     dest_pt_code_len;
  CBI_BYTE      dest_pt_code[CBI_MAX_DEST_PT_CODE_LEN];
} CBI_M2_MSG_FOR_XMISSION;
```

Parameters.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_MSG_FOR_XMISSION.

sender_handle - L3's handle for the join for this link.

receiver_handle - L2's handle for the join for this link.

pkt_hdr
Packet Header. See Section 6-1-4 for more information.

dest_pt_code_len
The number of valid characters in the **dest_pt_code** field.

dest_pt_code[]
The Destination Point Code for this link. MTP3 supplies this field in a form suitable for logging as a string of characters. The sole reason for supplying it is for logging purposes.

6-3-23. CBI_M2_OPEN

L3 sends this message to L2 during initialization, immediately after issuing the **`cbi_open()`** call. It opens a connection to the line card. L2 returns the signal as a response.

Data structure.

```
typedef struct cbi_m2_open
{
  CBI_IPS   ips_hdr;
  CBI_ULONG entity_index;
  CBI_BYTE  l1_framing[CBI_L1_MAX_FRAMERS];
  CBI_BYTE  l1_clocking[CBI_L1_MAX_FRAMERS];
  CBI_BYTE  l1_line_type[CBI_L1_MAX_FRAMERS];
  CBI_BYTE  l1_line_code[CBI_L1_MAX_FRAMERS];
  CBI_BYTE  l1_line_build_out[CBI_L1_MAX_FRAMERS];
  CBI_BUF_SIZE send_ctrl_tail_size;
  CBI_BUF_SIZE send_data_hdr_size;
  CBI_BUF_SIZE send_data_tail_size;
  CBI_ULONG return_code;
} CBI_M2_OPEN;
```

Parameters.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_OPEN.

sender_handle - not valid

receiver_handle - not valid

entity_index
The entity index of the requesting L3.

l1_framing [CBI_L1_MAX_FRAMERS]
The type of physical framing for each framer on the line card. The types are:

CBI_L1_FRAMING_NONE - undefined

CBI_L1_FRAMING_E1 - E1 framing

CBI_L1_FRAMING_T1 - T1 framing

l1_clocking [CBI_L1_MAX_FRAMERS]
The type of transmit clocking for each physical framer on the line card:

CBI_L1_CLOCKING_LOOP - use recovered Rx clock as Tx clock.

CBI_L1_CLOCKING_LOCAL - drive Tx clock directly from local clock.

CBI_L1_CLOCKING_THROUGH - drive the Tx clock from the recovered Rx clock from another port.

l1_line_type [CBI_L1_MAX_FRAMERS]
The physical line type for each framer on the line card. The types are:

CBI_HM_DS1LF_D4 - T1/D4

CBI_HM_DS1LF_D4_MF - T1/MultiFrame

CBI_HM_DS1LF_ESF - T1 extended Super Frame

CBI_HM_DS1LF_ESF_MF

CBI_HM_DS1LF_E1 - E1/no CRC

CBI_HM_DS1LF_E1_CRC- E1/CRC

CBI_HM_DS1LF_E1_MF - E1/MultiFrame

CBI_HM_DS1LF_E1_CRC_MF - E1/MultiFrame, CRC4

l1_line_code [CBI_L1_MAX_FRAMERS]
The physical line code for each framer on the line card. The types are:

CBI_HM_DS1_PHYS_ENC_B8ZS - B8ZS

CBI_HM_DS1_PHYS_ENC_AMI - AMI

CBI_HM_DS1_PHYS_ENC_HDB3 - HDB3

l1_line_build_out [CBI_L1_MAX_FRAMERS]
The line build out for each framer on the line card. In E1, this is the line impedance. In T1, it is the line length in feet. The types are:

CBI_HM_DS1_E1_IMPEDANCE_75_OHM

CBI_HM_DS1_E1_IMPEDANCE_120_OHM

CBI_HM_DS1_E1_IMPEDANCE_75_OHM_HIGH

CBI_HM_DS1_E1_IMPEDANCE_120_OHM_HIGH

CBI_HM_DS1_T1_LINE_LEN_0_TO_133FT

CBI_HM_DS1_T1_LINE_LEN_133_TO_266FT

CBI_HM_DS1_T1_LINE_LEN_266_TO_399FT

CBI_HM_DS1_T1_LINE_LEN_399_TO_533FT

CBI_HM_DS1_T1_LINE_LEN_533_TO_655FT

Parameters on response.

send_ctrl_tail_size
On response, this field contains the size of additional empty space that the application must provide at the end of all control packets it passes to the CBI library.

send_data_hdr_size
On response, this field contains the size of additional free space at the start of all data packets that the application passes to the CBI library.

send_data_tail_size
On response, this field contains the size of additional free space at the end of all data packets that the application passes to the CBI library.

Return code.
On response, this field indicates whether the open was successfully processed. The following values are allowed:

CBI_OK	The open message succeeded.
CBI_UNSUCCESSFUL	The open message did not succeed.

6-3-24. CBI_M2_OUT_OF_SERVICE

L2 sends this message to the L3 when the link fails and can no longer be used to transmit data packets.

There is no response to this message.

Data structure.

```
typedef struct cbi_m2_out_of_service
{
  CBI_IPS       ips_hdr;
} CBI_M2_OUT_OF_SERVICE;
```

Parameters.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_OUT_OF_SERVICE.

sender_handle - L2's handle for the join for this link.

receiver_handle - L3's handle for the join for this link.

6-3-25. CBI_M2_QUERY_CONFIG

The L3 sends this signal to L2 to request configuration information. L2 returns the signal as a response.

Data structure.

```
typedef struct cbi_m2_query_config
{
  CBI_IPS             ips_hdr;
  CBI_ULONG           return_code;
  CBI_M2_COMMON_PARMS common;
  CBI_M2_MTP2_PARMS   mtp2;
  CBI_M2_SAAL_PARMS   saal;
} CBI_M2_QUERY_CONFIG;
```

Parameters on request.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_QUERY_CONFIG.

sender_handle - L3's handle for the join for this link.

receiver_handle - L2's handle for the join for this link.

Parameters on response.

ips_hdr
IPS Header. For definition, see Section 6-1-1. Handles from request are swapped.

return_code
Return code indicating whether the query was successful. This field can take the following values:

CBI_OK	The query was successful.
CBI_UNSUCCESSFUL	The query failed.

common
Common L2 parameters. See Section 6-1-1.

mtp2
MTP2 specific parameters. See Section 6-1-2.

saal
Not used in MTP2 implementations.

6-3-26. CBI_M2_QUERY_STATS

The L3 sends this signal to L2 to request the return of statistical information. L2 returns the signal as a response.

Data structure.

```
typedef struct cbi_m2_query_stats
{
  CBI_IPS             ips_hdr;
  CBI_HANDLE          correlator;
  CBI_ULONG           return_code;
  CBI_BYTE            reset_stats;
  CBI_M2_COMMON_STATS common;
  CBI_M2_MTP2_STATS   mtp2;
  CBI_M2_SAAL_STATS   saal;
} CBI_M2_QUERY_STATS;
```

Substructures.

```
typedef struct cbi_m2_common_stats
{
                 CBI_ULONG duration_in_service;
                 CBI_ULONG    num_align_failures;
                 CBI_ULONG    num_retrans_rqs_sent;
                 CBI_UINT64   num_sd_trans;
                 CBI_UINT64   num_sd_rcvd;
                 CBI_ULONG
num_cong_msgs[CBI_M2_MAX_NUM_CONG_LEVELS + 1];
                 CBI_ULONG
cong_duration[CBI_M2_MAX_NUM_CONG_LEVELS + 1];
                 CBI_ULONG
num_msgs_discarded[CBI_M2_MAX_NUM_CONG_LEVELS + 1];
                 CBI_ULONG
num_cong_with_discard[CBI_M2_MAX_NUM_CONG_LEVELS + 1];
                 CBI_UINT64  num_sd_bytes_trans;
                 CBI_UINT64   num_sd_bytes_retrans;
                 CBI_UINT64   num_sd_bytes_rcvd;
} CBI_M2_COMMON_STATS;

typedef struct cbi_m2_mtp2_stats
{
  CBI_ULONG    neg_ack_rcvd;
  CBI_ULONG    busy_lssu_sent;
} CBI_M2_MTP2_STATS;

typedef struct cbi_m2_saal_stats
{
   /*Not used in MTP2*/
}
```

Parameters on request.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_QUERY_STATS.

sender_handle - L3's handle for the join for this link.

receiver_handle - L2's handle for the join for this link.

correlator
Correlator field is supplied on the request and returned on the response.

reset_stats
Indicates if and how L2 should reset any of the statistics to zero. This field can take the following values:

CBI_YES	After processing this request, L2 should set to zero all (and only) the internal statistics whose corresponding field in the CBI_M2_COMMON_STATS structures is non-zero. All the fields in the CBI_M2_MTP2_STATS and CBI_M2_SAAL_STATS structures should be reset to zero unconditionally.
CBI_NO	L2 should not reset any internal statistics.

Parameters on response.

ips_hdr
IPS Header. For definition, see Section 6-1-1. Handles from request are swapped.

correlator
Correlator field is supplied on the request and returned on the response.

return_code
Return code indicating whether the query was successful. This field can take the following values:

CBI_OK	The query was successful.
CBI_UNSUCCESSFUL	The query failed.

common

common.**duration_in_service**
The length of time that the status of the link has been CBI_M2_LINK_IN_SERVICE. This parameter is a cumulative count; it applies to the total length of time that the link has been active since the counter was last reset.

common.**num_align_failures**
The total number of link alignment failures.

common.**num_retrans_rqs_sent**
The number of sequenced data messages for which L2 had to request retransmission.

common.**num_sd_trans**
The total number of sequenced data messages transmitted.

common.**num_sd_rcvd**
The total number of sequenced data messages received.

common.**num_cong_msgs**
The total number of CBI_M2_LINK_CONGESTED messages which L2 has sent to L3 for each congestion level.

If the International, single congestion level is configured, then the first entry (index 0) contains the number of congested signals sent.

If the National option of multiple congestion levels is configured, then the number of congested signals for congestion levels 1–3 are stored in array indexes 1–3.

common.**cong_duration**
The total time, in seconds, that the transmitter has experienced congestion for each congestion level that is configured. This is a cumulative count, and includes all the individual periods of congestion for that level.

If the International, single congestion level is configured, the duration of congestion is stored in the first entry (index 0).

If the National option of multiple congestion levels is configured, then the durations of congestion for levels 1–3 are stored in array indexes 1–3.

common.**num_msgs_discarded**
The total number of messages discarded because of transmission congestion for the different congestion/discard levels (possibly just one level).

The first entry (index 0) always holds the number of messages discarded due to hitting the absolute discard limit.

If the National option of multiple congestion discard levels is configured, then the number of messages discarded for levels 1–3 are stored in array indexes 1–3.

common.**num_cong_with_discard**
The total number of congestion events (for each congestion level) which resulted in one or more messages being discarded.

If the International, single congestion discard level is configured, the number of congestion events which resulted in one or more messages being discarded is stored in the first entry (index 0).

If the National option of multiple congestion discard levels is configured, then the number of such events for levels 1–3 are stored in array indexes 1–3.

common.**num_sd_bytes_trans**
The number of sequenced data bytes transmitted.

common.**num_sd_bytes_retrans**
The number of sequenced data bytes retransmitted.

common.**num_sd_bytes_rcvd**
The number of sequenced data bytes received.

mtp2
MTP2 specific parameters.

mtp2.**neg_ack_rcvd**
The total number of negative acknowledgements received.

mtp2.**busy_lssu_sent**
The total number of Busy LSSU SIBs transmitted.

saal
Not used in MTP2 implementations.

6-3-27. CBI_M2_QUERY_STATUS

The L3 sends this signal to L2 to request link status information.

L2 sends this signal in response.

Data structure.

```
typedef struct cbi_m2_query_status
{
  CBI_IPS            ips_hdr;
  CBI_BYTE           cong_level;
  CBI_BYTE           link_status;
  CBI_BYTE           ups;
  CBI_BYTE           lpo;
  CBI_BYTE           retrieval_pending;
  CBI_BYTE           link_avail_status;
  CBI_BYTE           update_parms_pending;
  CBI_ULONG          event_code;
  CBI_M2_MTP2_STATUS mtp2;
} CBI_M2_QUERY_STATUS;
```

Substructure.

```
typedef struct cbi_m2_mtp2_status
{
  CBI_BYTE      rpo;
  CBI_BYTE      continue_pending;
  CBI_BYTE      rtb_cleared_pending;
  CBI_BYTE      rb_cleared_pending;
} CBI_M2_MTP2_STATUS;
```

Parameters on request.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_QUERY_STATUS.

sender_handle - L3's handle for the join for this link.

receiver_handle - L2's handle for the join for this link.

Parameters on response.

ips_hdr
IPS Header. For definition, see Section 6-1-1. Handles from request are swapped.

cong_level
The current congestion level. For single congestion thresholds, 0 means Not Congested, and 1 means Congested. For multiple congestion levels, this field can take values 0 - **num_cong_levels** (from M2_UPDATE_PARMS) inclusive. Constants for the congestion level in use by L2. This field can take the following values:

- CBI_M2_CONG_LEVEL_1
- CBI_M2_CONG_LEVEL_2
- CBI_M2_CONG_LEVEL_3
- CBI_M2_CONG_NONE

link_status
The link status. This field can take the following values:

- CBI_M2_LINK_ALIGNED
- CBI_M2_LINK_ALIGNING
- CBI_M2_LINK_IN_SERVICE
- CBI_M2_LINK_OUT_OF_SERVICE
- CBI_M2_LINK_PROVING

ups
This is the User Proving Status (proving mode requested by L3). This field can take the following values:

- CBI_M2_UPS_NORMAL
- CBI_M2_UPS_EMERGENCY

lpo
The status of a Local Processor Outage. This field can take the following values:

- CBI_M2_LPO_RECOVERED
- CBI_M2_LPO_OUTAGE

retrieval_pending
Message retrieval status. This indicates whether L2 has a pending Message Retrieval request outstanding. If so, then L2 will send these messages to the L3 process which issued the CBI_M2_MGMT_REGISTER signal. This field can take the following values:

CBI_YES	L2 has a pending retrieval request outstanding.
CBI_NO	L2 does not have a pending retrieval request outstanding.

link_avail_status
The availability status. This field can take the following values:

CBI_M2_AVAIL_UNDEFINED	The L2 has not sent a CBI_M2_AVAILABLE or a CBI_M2_UNAVAILABLE signal to the L3 yet.
CBI_M2_AVAILABLE	The L2 has sent a CBI_M2_AVAILABLE to the L3, and has never sent a CBI_M2_UNAVAILABLE.
CBI_M2_UNAVAILABLE	The L2 has sent a CBI_M2_UNAVAILABLE signal to the L3.

update_parms_pending
Update parameters SET or CANCEL pending. This field indicates whether L2 has received and processed a CBI_M2_UPDATE_PARMS TEST and is currently expecting a SET or CANCEL to follow.

CBI_YES	L2 is expecting a pending SET or CANCEL.
CBI_NO	L2 is not expecting a pending SET or CANCEL.

event_code
Event Registration status. Flags for the events for which L3 is currently registered to receive notifications. This field can take a combination of the values, combined using a bitwise OR. Constants for indication types:

CBI_M2_EV_LINK_STATUS	Changes in link status.
CBI_M2_EV_SL_FAIL_ALL	Link failure - all reasons.
CBI_M2_EV_SL_FAIL_FIBR_BSNR	Link failure - abnormal FIBR/BSNR.
CBI_M2_EV_SL_FAIL_NO_RSP	Link failure because the partner L2 process failed to respond within the required time.
CBI_M2_EV_SL_FAIL_ERROR_RATE	Link failure because the Error Monitor has failed the link.
CBI_M2_EV_SL_FAIL_CONG_DELAY	Link failure because L2 has been without send credit for longer than the allowed period.
CBI_M2_EV_CONG_WITH_DISCARD_1	The first message has been discarded at discard level 1 after moving to this level.
CBI_M2_EV_CONG_WITH_DISCARD_2	The first message has been discarded at discard level 2 after moving to this level.
CBI_M2_EV_CONG_WITH_DISCARD_3	The first message has been discarded at discard level 3 after moving to this level.
CBI_M2_EV_ALL_EVENTS	Any of the events listed above have occurred.

mtp2
MTP2-specific status fields, as follows:

mtp2.**rpo**
This indicates the status of a Remote Processor Outage. This field can take the following values:

- CBI_M2_RPO_RECOVERED
- CBI_M2_RPO_OUTAGE
- CBI_M2_RPO_PENDING_CONTINUE

mtp2.**continue_pending**
Continue status. This indicates whether L2 is currently awaiting a CBI_M2_CONTINUE, CBI_M2_FLUSH_BUFFERS, or CBI_M2_CLEAR_RTB request from the L3, following the end of a local or remote processor outage condition.

- CBI_YES L2 is waiting for a CBI_M2_CONTINUE, CBI_M2_FLUSH_BUFFERS, or CBI_M2_CLEAR_RTB signal.
- CBI_NO L2 is not waiting for such a signal.

mtp2.**rtb_cleared_pending**
Clear RTB status. This indicates whether L2 currently "owes" the L3 a CBI_M2_RTB_CLEARED response after a CBI_M2_CLEAR_RTB or CBI_M2_FLUSH_BUFFERS request.

- CBI_YES L2 owes a CBI_M2_RTB_CLEARED response and will send one when ready.
- CBI_NO L2 does not owe a CBI_M2_RTB_CLEARED response.

mtp2.**rb_cleared_pending**
Clear RB status. This indicates whether L2 currently "owes" the L3 a CBI_M2_RB_CLEARED response after a CBI_M2_FLUSH_BUFFERS request.

- CBI_YES L2 owes a CBI_M2_RB_CLEARED response and will send one when ready.
- CBI_NO L2 does not owe a CBI_M2_RB_CLEARED response.

6-3-28. CBI_M2_RB_CLEARED

L2 sends this message to the L3 to indicate that the receive buffer has been cleared, as requested by the L3 in a CBI_M2_FLUSH_BUFFERS request. This message is sent only when the major variant is ANSI. This message is received when issued from a processor outage state.

There is no response to this message.

Data structure.

```
typedef struct cbi_m2_rb_cleared
{
  CBI_IPS       ips_hdr;
} CBI_M2_RB_CLEARED;
```

Parameters.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_RB_CLEARED.

sender_handle - L2's handle for the join for this link.

receiver_handle - L3's handle for the join for this link.

6-3-29. CBI_M2_RECEIVED_MESSAGE

The L2 sends this message to the L3 to pass it a data message received from the partner L2 process.

There is no response to this message.

Note that the L2 requires that the L3:

- either release the buffer immediately when the data has been processed.
- or queue the buffer in the short term to exert back-pressure on L2's receipt of messages from the partner L2 process.

The L3 or other product must not simply save the buffer to be used for its own purposes in the future. If this does happen, then this will reduce the rate at which the L2 can receive data from the partner L2 process, possibly to the point where it can no longer receive any data from the partner.

Data structure.

```
typedef struct cbi_m2_received_message
{
  CBI_IPS       ips_hdr;
  CBI_PKT_HDR   pkt_hdr;
} CBI_M2_RECEIVED_MESSAGE;
```

Parameters.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_RECEIVED MESSAGE.

sender_handle - L2's handle for the join for this link.

receiver_handle - L3's handle for the join for this link.

pkt_hdr
Packet Header. See Section 6-1-4 for more information.

6-3-30. CBI_M2_REM_PROCSSR_OUTAGE

L2 sends this message to the L3 to indicate that the remote end of the link is transmitting status signal units indicating processor outage.

There is no response to this message.

Data structure.

```
typedef struct cbi_m2_rem_procssr_outage
{
  CBI_IPS       ips_hdr;
} CBI_M2_REM_PROCSSR_OUTAGE;
```

Parameters.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_REM_PROCSSR_OUTAGE.

sender_handle - L2's handle for the join for this link.

receiver_handle - L3's handle for the join for this link.

6-3-31. CBI_M2_REM_PROCSSR_RECOVRD

L2 sends this message to the L3 to indicate that the remote end of the link has indicated that a processor outage condition has ended.

There is no response to this message.

Data structure.

```
typedef struct cbi_m2_rem_procssr_recovrd
{
  CBI_IPS       ips_hdr;
} CBI_M2_REM_PROCSSR_RECOVRD;
```

Parameters.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_REM_PROCSSR_RECOVRD.

sender_handle - L2's handle for the join for this link.

receiver_handle - L3's handle for the join for this link.

6-3-32. CBI_M2_RETRIEVAL_COMPLETE

L2 sends this message to the L3 once all data messages have been returned in response to a CBI_M2_RETRIEVAL_REQ_FSNC message. This includes the case when there are no data messages to return.

There is no response to this message.

Data structure.

```
typedef struct cbi_m2_retrieval_complete
{
  CBI_IPS       ips_hdr;
} CBI_M2_RETRIEVAL_COMPLETE;
```

Parameters.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_REM_RETRIEVAL_COMPLETE.

sender_handle - L2's handle for the join for this link.

receiver_handle - L3's handle for the join for this link.

6-3-33. CBI_M2_RETRIEVAL_NOT_POSS

L2 sends this message to the L3 in response to a CBI_M2_RETRIEVAL_REQ_FSNC message when the L2 is unable to send any retrieved messages to the L3. A CBI_M2_RETRIEVAL_COMPLETE message is sent if there are no messages to be returned.

There is no response to this message.

Data structure.

```
typedef struct cbi_m2_retrieval_not_poss
{
  CBI_IPS       ips_hdr;
} CBI_M2_RETRIEVAL_NOT_POSS;
```

Parameters.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_REM_RETRIEVAL_NOT_POSS.

sender_handle - L2's handle for the join for this link.

receiver_handle - L3's handle for the join for this link.

6-3-34. CBI_M2_RETRIEVAL_REQ_FSNC

The L3 sends this message to the L2 to request that it return data messages that were previously sent by the L3 for transmission by the L2, but which have not yet been acknowledged by the peer L2 process. The messages to be returned are those starting from the one after the given sequence number.

The L2 returns the messages using CBI_M2_RETRIEVED_MESSAGE messages on the L2 - L3 Management Interface.

Data structure.

```
typedef struct cbi_m2_retrieval_req_fsnc
{
  CBI_IPS       ips_hdr;
  CBI_ULONG     fsnc;
} CBI_M2_RETRIEVAL_REQ_FSNC;
```

Parameters.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_RETRIEVAL_REQ_FSNC.

sender_handle - L2's handle for the join for this link.

receiver_handle - L3's handle for the join for this link.

fsnc
Messages with send sequence number greater than the value in **fsnc** are returned, in order, by the L2. The valid range for **fsnc** is 0 to 2^24 - 1.

6-3-35. CBI_M2_RETRIEVED_MESSAGE

L2 sends this message to the L3 to return a data message requested by the L3 using a CBI_M2_RETRIEVAL_REQ_FSNC message.

There is no response to this message.

Data structure.

```
typedef struct cbi_m2_retrieved_message
{
  CBI_IPS       ips_hdr;
  CBI_PKT_HDR   pkt_hdr;
} CBI_M2_RETRIEVED_MESSAGE;
```

Parameters.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_REM_RETRIEVED_MESSAGE.

sender_handle - L2's handle for the join for this link.

receiver_handle - L3's handle for the join for this link.

pkt_hdr
Packet Header. See Section 6-1-4 for more information.

6-3-36. CBI_M2_RETRIEVE_BSNT

The L3 sends this message to L2 to request that it process all data messages received so far, and then send a CBI_M2_BSNT signal back to the L3 to inform it of the sequence number of the last received message.

In the case where the sequence number cannot be obtained, the L2 sends back a CBI_M2_BSNT_NOT_RETRIEVABL message.

Data structure.

```
typedef struct cbi_m2_retrieve_bsnt
{
  CBI_IPS       ips_hdr;
} CBI_M2_RETRIEVE_BSNT;
```

Parameters.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_RETRIEVE_BSNT.

sender_handle - L3's handle for the join for this link.

receiver_handle - L2's handle for the join for this link.

6-3-37. CBI_M2_RTB_CLEARED

L2 sends this message to the L3 to indicate that the retransmission buffer has been cleared, as requested by the L3 in a CBI_M2_CLEAR_RTB or CBI_M3_FLUSH_BUFFERS request. This message is only sent when the major variant is ANSI. This message is received from an out-of-service state or a processor outage state.

There is no response to this message.

Data structure.

```
typedef struct cbi_m2_rtb_cleared
{
  CBI_IPS       ips_hdr;
} CBI_M2_RTB_CLEARED;
```

Parameters.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_RTB_CLEARED.

sender_handle - L2's handle for the join for this link.

receiver_handle - L3's handle for the join for this link.

6-3-38. CBI_M2_START

The L3 sends this message to L2 to request that it start alignment procedures with its peer L2 process.

There is no direct response to this message, but if the alignment procedures succeed, L2 sends a CBI_M2_IN_SERVICE message to the L3.

Data structure.

```
typedef struct cbi_m2_start
{
  CBI_IPS       ips_hdr;
} CBI_M2_START;
```

Parameters.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_START.

sender_handle - L3's handle for the join for this link.

receiver_handle - L2's handle for the join for this link.

6-3-39. CBI_M2_STOP

The L3 sends this message to L2 to request that it stop sending data to its peer L2 process.

There is no response to this message.

Data structure.

```
typedef struct cbi_m2_stop
{
  CBI_IPS       ips_hdr;
} CBI_M2_STOP;
```

Parameters.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_STOP.

sender_handle - L3's handle for the join for this link.

receiver_handle - L2's handle for the join for this link.

6-3-40. CBI_M2_UNAVAILABLE

An L2 sends this signal to the L3 to notify it that the join to the L2-L3 Data Interface has permanently failed, and the L2 is unable to support the link. When the L3 receives this message, it unjoins with the L2. This signal may be sent instead of a CBI_M2_AVAILABLE signal (as the next signal after responding to a CBI_M2_REGISTER request), if the L2 is unable to join to the L2-L3 Data Interface.

There is no response to this message.

Data structure.

```
typedef struct cbi_m2_unavailable
{
  CBI_IPS       ips_hdr;
} CBI_M2_UNAVAILABLE;
```

Parameters.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_REM_UNAVAILABLE.

sender_handle - L2's handle for the join for this link.

receiver_handle - L3's handle for the join for this link.

6-3-41. CBI_M2_UPDATE_PARMS

The L3 sends this signal to L2 to define dynamically changeable parameters in L2. It can be sent at any time after L2 has been created. L2 returns the signal as a response.

To configure the L2, an L3 must send at least one CBI_M2_UPDATE_PARMS signal after registering with the L2, before it sends a CBI_M2_START. If CBI_M2_UPDATE_PARMS is never issued, then the parameters take their default values.

Note that if parameters controlling link proving are changed when the link is active, this may cause the link to be failed erroneously or allow a link of unacceptable quality to remain in service.

If a CBI_M2_UPDATE_PARMS is outstanding in the L2 when the L3 fails over, the request should be processed to completion, but the response should be discarded.

Further, a backup L3 must not make a new CBI_M2_UPDATE_PARMS request until it has issued and received a response to a CBI_M2_QUERY_STATUS. In turn, the L2 should delay the response to the CBI_M2_QUERY_STATUS until it can accept a new CBI_M2_UPDATE_PARMS request.

Data structure.

```
typedef struct cbi_m2_update_parms
{
  CBI_IPS              ips_hdr;
  CBI_ULONG            return_code;
  CBI_BYTE             update_type;
  CBI_M2_COMMON_PARMS  common;
  CBI_M2_MTP2_PARMS    mtp2;
  CBI_M2_SAAL_PARMS    saal;
} CBI_M2_UPDATE_PARMS;
```

CBI_M2_COMMON_PARMS is documented in Section 6-1-1 of this manual.

CBI_M2_MTP2_PARMS is documented in Section 6-1-2 of this manual.

CBI_M2_SAAL_PARMS is not used in MTP2 implementations and should be zeroed.

Parameters on request.

ips_hdr
IPS Header. For definition, see Section 6-1-1. The following fields are specified below:

ips_type - IPS_CBI_M2_UPDATE_PARMS.

sender_handle - L3's handle for the join for this link.

receiver_handle - L2's handle for the join for this link.

update_type
This field determines how L2 applies the specified configuration parameters. This field can take the following values:

CBI_M2_UPDATE_TEST	This value instructs L2 to check that the specified parameters are acceptable (but not to apply them). If the parameters are not acceptable, then the request is rejected. If the parameters are acceptable, then L2 must accept a subsequent CBI_M2_UPDATE_PARMS with an **update_type** set to CBI_M2_UPDATE_SET carrying the same parameter values. In processing this request, L2 may have allocated some resources in anticipation of a subsequent request with **update_type** set to CBI_M2_UPDATE_SET.
CBI_M2_UPDATE_SET	This value instructs L2 to apply the supplied configuration parameters.
CBI_M2_UPDATE_CANCEL	This value cancels a previous request of **update_type** CBI_M2_UPDATE_TEST. This may allow L2 to release resources.

common
Common L2 parameters.

These fields can be changed on a CBI_M2_UPDATE_PARMS at any time, with the following exceptions:

- **cong_method**, **num_cong_levels** and **initial_status** can be changed only when the link is out of service.
- **rcv_pool_capacity** must never be changed after the first CBI_M2_UPDATE_PARMS signal sent by the L3 to the L2 after registering.

mtp2
MTP2-specific parameters.

These fields can be set only on the first CBI_M2_UPDATE_PARMS request sent by L3 after registering, and must not be changed later, with the following exceptions:

- **max_proving_attempts** may be changed at any time when the link is out of service.
- the fields in **timers** and **rcv_congestion** may be changed at any time.

saal
Not used in MTP2 implementations and should be zeroed.

Parameters on response.

ips_hdr
IPS Header. For definition, see Section 6-1-1. Handles from request are swapped.

return_code
Return code indicating whether the update was successful. This field can take the following values:

CBI_OK	The update was successful.
CBI_INVALID_TIMER_VALUES	One or more timer value was incorrect.
CBI_RESOURCE_FAILURE	The update failed because L2 could not obtain the required resources (for example, because of a memory shortage).
CBI_UNSUCCESSFUL	The update failed for another reason.

7. Data Path Routing (DPR)

7-1. dprservice (7D)

The DPR service is a part of all protocol support packages for SBE's HighWire boards. The host interface to the DPR service is implemented using the streams putmsg(2) and getmsg(2) calls. Each exchange consists of first a putmsg with the command in the structure sent as the control part of the putmsg and a data buffer if required by the command. The response to the command is received using a getmsg with control and data buffers large enough to receive the response. The received control part has the same command as was sent with a possible error code. Any parameters returned will follow in the control buffer or in the data buffer as appropriate. The only commands that use the data buffer are the read, write and print/report commands; write on the putmsg call and the others on the getmsg call.

Although for every putmsg there will be a getmsg response, there is no requirement that each putmsg be immediately followed by a getmsg, only that there be one getmsg for each putmsg. That is, a whole sequence of putmsg calls may be issued to set up the DPR followed by the getmsg calls to retrieve their responses.

The DPR_ENABLE_CLKERR_CALLBACK command is special because it enables the board to send unsolicited messages to the host program. The host must have a task waiting to receive these messages with a getmsg at any time and deal with them as appropriate. This may be accomplished with a task hanging on getmsg or by setting the file descriptor to non-blocking and call getmsg periodically in a loop.

The libdpr (3sbe) provides an alternate method to controlling the DPR service using read-, write-, and ioctl-like functions. See Section 7-2, *libdpr (3sbe)*.

Synopsis

```
#include "sbe_types.h"
#define __INCboardh         /* prevent including the board.h file */
#include "dprd_if.h"
#include "sbe_lib.h"
#include "uppa.h"
#include <fcntl.h>
#include <sys/stropts.h>
int fildes;
struct strbuf prctl;
fildes = sbe_dataOpen (DPR_SERVICE, board, 0, oflags);
...
error = putmsg (fildes, &prctl, 0);         /* if no data buffer to send */
error = getmsg (fildes, &prctl, 0);         /* if no data buffer will be received */
cc -I/usr/include/sbe -lsbe -lsocket -lposix4 ...
```

Availability Provided as a component of the SBE HighWire and LinkWARE Support Packages.

Commands Commands to the DPR service are sent in the control part of the putmsg call. The first 32-bit integer in the control message's buffer consists of the command to be executed in the low order byte and the value DPR_PROTO_CODE in the next higher byte. Additional parameters for the command follow in the control buffer or, in the case of DPR_WRITE, in the data buffer. The structures that define the contents of the control buffer are defined in dprd_if.h and described with their associated commands below.

The response to the command is received with a getmsg call. In the control buffer received the first 32-bit word contains an error code in the upper 16-bits and the original command in the low order 16-bits. These are accessible in the command associated structures as elements xxxx_fun and xxxx_err, where xxxx depends on the structure for the command.

DPR_READ. Reads the current DPR connection matrix.

The putmsg control buffer is a structure of type dpr_rdwr_t with the rdwr_size element set to the maximum number of connections to be returned. The getmsg control buffer returned is also a dpr_rdwr_t structure with the error code in the rdwr_err element and the number of connections returned in the rdwr_size element. The getmsg data buffer must be large enough to receive MAP structures for the maximum number of connections specified in the putmsg call. See DPR_CONNECT for information on the MAP structure.

The sbe_dprRead routine from libsbe listed below shows one method to issue this command and get the response.

```
int
sbe_dprRead (int fd, MAP *buf, int size)
{ int err; /* err code */
   int flag; /* flag, set to non-priority msg */
   struct strbuf rdctl; /* structure for control part of msg */
   struct strbuf rddata; /* structure for data part of msg */
   dpr_rdwr_t rdproto; /* request/response control structure */

   /*
   * Set up the DPR_READ command and send it to the board.
   */
   rdproto.rdwr_fun = (DPR_PROTO_CODE << 8) | DPR_READ;
   rdproto.rdwr_size = size;
   rdctl.maxlen = sizeof (rdproto);
   rdctl.len = sizeof (rdproto);
   rdctl.buf = (char *)&rdproto;
      if (!(err = putmsg (fd, &rdctl, 0, 0))) { /*
      * Set up to get the response from the board.
      */
      rdctl.maxlen = sizeof (rdproto);
      rdctl.len = 0;
      rdctl.buf = (char *)&rdproto;
      rddata.maxlen = size * sizeof (MAP);
```

```
      rddata.len = 0;
      rddata.buf = (char *)buf;
      flag = 0;
      if (!(err = getmsg (fd, &rdctl, &rddata, &flag))) {
         if (!(err =    rdproto.rdwr_err))
            { /*
               * If no error, return the amount read.
               * Set the reference map address for test routines.
               */
               err = rdproto.rdwr_size;
            }
         }
   }
   return (err);
}
```

DPR_WRITE. Writes the DPR connection matrix to the board replacing all current connections.

The putmsg control buffer is a structure of type dpr_rdwr_t with the rdwr_size element set to the number of connections supplied in the data buffer. The connections are specified using the MAP structures shown in the DPR_CONNECT command. The getmsg control buffer returned is also a dpr_rdwr_t structure with the error code in the rdwr_err element (zero on success).

DPR_CONNECT. Connects one time slot from a source to a destination.

The putmsg control buffer is a structure of type dpr_conn_t with the conn_map element a MAP structure that defines the source and destination for the connection. The getmsg control buffer returned is also a dpr_conn_t structure with the error code in the conn_err element, which is zero on success.

The elements of the MAP structure are:

UINT32 fromDev	Source time slot made up by using the macros PUT_TIMESLOT(t) | PUT_CHAN(c) | PUT_DEVICE(d)
UINT32 toDev	Destination time slot made up by using the above macros
UINT32 mode	TSI transmission mode for connect as follows:
	TTSI_LOWLAT Low-latency mode
	TTSI_FRAMEI Frame-integrity mode
	TTSI_HOST Host data substitution mode
	TTSI_IDLE1 Put idle code1 on the TDM highway
	TTSI_IDLE2 Put idle code2 on the TDM highway
	TTSI_IDLE3 Put idle code3 on the TDM highway
	TTSI_TESTPAT Put test pattern on the TDM highway
	TTSI_TRISTATE Tri-state the TDM highway
INT32 connected	1 - TDM highway connection, 0 - disconnected, -1 - N/A
UINT32 ct_xmit_enable	1 - enable; 0 - disable
INT32 local_TSA_line	The local TSA TDM highway number (0-7) or -1 for N/A

The following example shows how to issue this command and get the response.

```
int err; /* err code */
int flag; /* flag, set to non-priority msg */
struct strbuf cnctl; /* structure for control part of msg */
dpr_conn_t cnproto; /* request/response control structure */

/*
* Set up the DPR_CONNECT command and send it to the board.
*/
cnproto.conn_df.df_fun = (DPR_PROTO_CODE << 8) | DPR_CONNECT;
cnproto.conn_map.fromDev = PUT_TIMESLOT(2) | PUT_CHAN(9) | PUT_DEVICE(CM_TT_TS704);
cnproto.conn_map.toDev = PUT_TIMESLOT(2) | PUT_CHAN(1) | PUT_DEVICE(CM_TT_COMET);
cnproto.conn_map.mode = TTSI_LOWLAT;
cnproto.conn_map.connected = -1;
cnproto.conn_map.ct_xmit_enable = 0;
cnproto.conn_map.local_TSA_line = -1;
cnctl.maxlen = sizeof (cnproto);
cnctl.len = sizeof (cnproto);
cnctl.buf = (char *)&cnproto;
if (!(err = putmsg (fd, &cnctl, 0, 0)))
   { /*
   * Set up to get the response from the board.
```

```
   */
   cnctl.maxlen = sizeof (cnproto);
   cnctl.len = 0;
   cnctl.buf = (char *)&cnproto;
   flag = 0;
   if (!(err = getmsg (fd, &cnctl, 0, &flag))) {
      err = cnproto.conn_df.df__err
   }
}
```

DPR_DISCONNECT. Disconnects one source time slot from a destination.

The putmsg control buffer is a structure of type dpr_conn_t. The conn_map element is a MAP structure that defines the source and destination for the connection. The getmsg control buffer returned is also a dpr_conn_t structure with the error code in the conn_err element (zero on success). The elements of the MAP structure are::

UINT32 fromDev	Source time slot made up by using the macros PUT_TIMESLOT(t) | PUT_CHAN(c) | PUT_DEVICE(d)
UINT32 toDev	Destination time slot made up by using the above macros
UINT32 mode	Indicates the scope of the disconnect command as follows:
	SPECIFIED — disconnect just the specified time slot from the source to the destination.
	ALL — disconnect all connections.
	ALL_H110 — disconnect all H.110 bus connections.
	ALL_COMETS — disconnect all Comet connections.
	ALL_TS70X — disconnect all TS704 connections.
INT32 connected	Unused
UINT32 ct_xmit_enable	Unused
INT32 local_TSA_line	The local TSA TDM highway number (0-7) or -1 for N/A

DPR_IS_TXCONNECTED. Checks if a source device, channel, and timeslot are connected.

The putmsg control buffer is a structure of type dpr_srch_t. The srch_conn element is an IOCTLTXRXCONNECT structure that defines the source for the connection. The getmsg control buffer returned is also a dpr_srch_t structure with the error code in the srch_df.df_err element (zero on success). Upon success and with a positive result index, the information on the first destination address found is in the srch_conn structure, which has the following elements:

UINT32 uiDevice	Transmit device supplied.
UINT32 uiChannel	Transmit channel supplied.
UINT32 uiTimeslot	Transmit time slot supplied.
UINT32 uiOtherDevice	Receiving device returned if there is one.
UINT32 uiOtherChannel	Receiving channel returned if there is one.
UINT32 uiOtherTimeslot	Receiving time slot returned if there is one.
INT32 uiResultIndex	Index of first receiving end found or –1 if there is no destination connected.

DPR_IS_RXCONNECTED. Checks if a receiving device, channel, and timeslot are connected.

The putmsg control buffer is a structure of type dpr_srch_t. The srch_conn element is an IOCTLTXRXCONNECT structure that defines the receiving end of the connection. The getmsg control buffer returned is also a dpr_srch_t structure with the error code in the srch_df.df_err element (zero on success). Upon success and with a positive result index, the source address is in the srch_conn structure. The above description of IOCTLTXRXCONNECT applies with the transmit and receive roles reversed.

DPR_PRIMARY_CLOCK. Configures the H.110/CT bus primary clock to use the specified clocking source.

The putmsg control buffer is a structure of type dpr_usel_t with the usel_val element specifying the clocking source. The getmsg control buffer returned is also a dpr_usel_t structure with the error code in the usel_err element (zero on success). The allowed clock source values are:

T8100_CLK_INTERNAL	Run the primary clock from the internal oscillator.
T8100_CLK_FRAMEA	Run the primary clock from Frame A.
T8100_CLK_FRAMEB	Run the primary clock from Frame B.
T8100_CLK_NETREF1	Run the primary clock from External Net Reference 1.
T8100_CLK_NETREF2	Run the primary clock from External Net Reference 2.
T8100_CLK_LREF0	Run the primary clock from Local Reference 0.
T8100_CLK_LREF1	Run the primary clock from Local Reference 1.
T8100_CLK_LREF2	Run the primary clock from Local Reference 2.
T8100_CLK_LREF3	Run the primary clock from Local Reference 3.
T8100_CLK_LREF4	Run the primary clock from Local Reference 4.
T8100_CLK_LREF5	Run the primary clock from Local Reference 5.
T8100_CLK_LREF6	Run the primary clock from Local Reference 6.
T8100_CLK_LREF7	Run the primary clock from Local Reference 7.

DPR_FALLBACK_CLOCK. Configures the H.110/CT bus fallback or secondary clock to use the specified clocking source.

The putmsg control buffer is a structure of type dpr_usel_t with the usel_val element specifying the clocking source. The getmsg control buffer returned is also a dpr_usel_t structure with the error code in the usel_err element (zero on success). The allowed clock source values are a subset of the possibilities for the primary clock. In particular, LREF0 and LREF4-7 are not available nor is the clock source that is used for the primary clock.

DPR_BUS_CLOCK. Selects a T8102 clock source to drive the local bus.

The putmsg control buffer is a structure of type dpr_usel_t with the usel_val element specifying the clocking source. The getmsg control buffer returned is also a dpr_usel_t structure with the error code in the usel_err element, which is zero on success. The allowed clock source values are:

T8100_CT_BUS_NO_CLK	Do not drive the local bus clock.
T8100_CT_BUS_CLK_A	Clock A to drive the local bus.
T8100_CT_BUS_CLK_B	Clock B to drive the local bus.
T8100_CT_BUS_CLK_AB	Clock A and B to drive the local bus.

DPR_BUS_NETREF. Sets the source for the NETREF signal.

The putmsg control buffer is a structure of type dpr_usel_t with the usel_val element containing the source setting using the macro SET_NETREF (assign, source). The getmsg control buffer returned is also a dpr_usel_t structure with the error code in the usel_err element, which is zero on success. The NETREFs that can be assigned are:

T8100_CT_BUS_NO_NETREF	No NETREF assigned to CT Bus.
T8100_CT_BUS_NETREF_1	NETREF1 assigned to CT Bus.
T8100_CT_BUS_NETREF_2	NETREF2 assigned to CT Bus.
T8100_CT_BUS_NETREF_12	Both NETREF1 and NETREF2 assigned to CT Bus.

The possible sources for the NETREF are:

T8100_CT_BUS_NETREF_SRC_OSC_8	Internal oscillator divided by 8.
T8100_CT_BUS_NETREF_SRC_OSC	Internal oscillator.
T8100_CT_BUS_NETREF_SRC_NETREF_1	Select NETREF1 as input.
T8100_CT_BUS_NETREF_SRC_NETREF_2	Select NETREF2 as input.
T8100_CT_BUS_NETREF_SRC_LREF0	Comet 0 (Local Reference).
T8100_CT_BUS_NETREF_SRC_LREF1	Comet 1 (Local Reference).
T8100_CT_BUS_NETREF_SRC_LREF2	Comet 2 (Local Reference).
T8100_CT_BUS_NETREF_SRC_LREF3	Comet 3 (Local Reference).
T8100_CT_BUS_NETREF_SRC_LREF4	Comet 4 (Local Reference).
T8100_CT_BUS_NETREF_SRC_LREF5	Comet 5 (Local Reference).
T8100_CT_BUS_NETREF_SRC_LREF6	Comet 6 (Local Reference).
T8100_CT_BUS_NETREF_SRC_LREF7	Comet 7 (Local Reference).

DPR_CLOCK_DIVISOR. Selects the divisor for the main clock, NETREFs, or resource divider.

The putmsg control buffer is a structure of type dpr_usel_t with the usel_val element containing the source setting using the macro SET_NETREF (divider, divisor) to select the clock divider to be set to the divisor. The getmsg control buffer returned is also a dpr_usel_t structure with the error code in the usel_err element, which is zero on success. The divisor may be any value from 0 to 255. The possible clock divider selections are:

T8100_CLOCK_DIVIDER_MAIN	Main Clock Divider
T8100_CLOCK_DIVIDER_NETREF	NETREF Divider
T8100_CLOCK_DIVIDER_RESOURCE	Resource Divider

DPR_CLR_CLKERR. Clears the clock error watchdogs in the T8102.

The putmsg control buffer is a structure of type dpr_func_t, which contains only the command. The getmsg control buffer returned is also a dpr_func_t structure with the error code in the df_err element, which is zero on success.

DPR_ENABLE_CLKERR_CALLBACK. Enables the specified clock error watchdogs in the T8102.

The putmsg control buffer is a structure of type dpr_cker_t. The cker_evt element is a CLKERREVENT structure that specifies the error watchdogs to enable. The getmsg control buffer returned is also a dpr_cker_t structure with the error code in the cker_df.df_err element (zero on success).

When a specified clock error occurs this command causes the board to send unsolicited clock error event messages on this file descriptor. Any getmsg call may return a clock error event instead of the response to a command's putmsg.

The elements in the CLKERROREVENT structure are listed below. Only the clkWdogMask and err3Data elements are set when issuing the command but all may be filled in on an error message. An unsolicited CLKERROREVENT message will have cker_fun set to DPR_CLKERR_DATA instead of the DPR_ENABLE_CLKERR_CALLBACK returned as the response to this command..

UINT32 clkWdogMask	CKW mask for what errors to enable: i.e., CKW_NETREF.
UINT32 errSource	error source: CLKERR1, CLKERR2, CLKERR3 or SYSERR.
UINT32 err1Data	error reason for CLKERR1.
UINT32 err2Data	error reason for CLKERR2.
UINT32 err3Data	error reason for CLKERR3; set bit 0 to enable NETREF2 error reporting.
UINT32 sysErrData	error reason for sysErr.

DPR_DISABLE_CLKERR_CALLBACK. Disables all clock error watchdogs in the T8102 and stop the board from sending unsolicited clock error messages to the application.

The putmsg control buffer is a structure of type dpr_func_t, which contains only the command. The getmsg control buffer returned is also a dpr_func_t structure with the error code in the df_err element, which is zero on success.

DPR_GET_CLOCK_INFO. Retrieves the current contents of the selected clocking registers in the T8102.

The putmsg control buffer is a structure of type dpr_ckin_t with the ckin_par element a T8100_CLOCK_INFO structure that contains only the command. The getmsg control buffer returned is also a dpr_ckin_t structure with the error code in the ckin_err element, which is zero on success. In that case, the clock information is in the ckin_par structure, which has the following elements:

UINT8 ckm	Master Clock Register
UINT8 ckn	NETREF Selection Register
UINT8 ckp	Programmable Outputs Register
UINT8 ckr	Clock Resource Selection Register
UINT8 cks	Secondary/Fallback Clock Register
UINT8 ck32	Local Clocks 2 and 3 Source Selection Register
UINT8 ckmd	Local Clocks 0 and 1 Source Selection Register
UINT8 cknd	Main Clock Source Divider Register
UINT8 ckrd	Resource Divider Register

DPR_SET_CLOCK_INFO. Sets the values of the selected clocking registers in the T8102.

The putmsg control buffer is a structure of type dpr_ckin_t. The ckin_par element is a T8100_CLOCK_INFO structure that contains the values for the T8102 clocking registers, as described in DPR_GET_CLOCK_INFO. The getmsg control buffer returned is also a dpr_ckin_t structure with the error code in the ckin_err element (zero on success).

DPR_DATA_ALIGNMENT. Sets the method to bring the data into alignment on a clock change.

The putmsg control buffer is a structure of type dpr_usel_t with the usel_val element the method for data alignment. The getmsg control buffer returned is also a dpr_usel_t structure with the error code in the usel_err element, which is zero on success. The data alignment methods are:

T8100_PHASE_ALIGN_NONE	The incoming frame is frequency locked to an inbound frame, but not phase aligned.
T8100_PHASE_ALIGN_SNAP	Instantaneous phase alignment at the frame boundary.
T8100_PHASE_ALIGN_SLIDE	A fraction of a bit time is removed from each frame until sync is achieved.

DPR_MODE. Changes the mode of operation for the Time Slot Interchanger (TSI).

The putmsg control buffer is a structure of type dpr_mode_t with the mode_tsi element a IOCTLTSIMODE structure that specifies the mode. The getmsg control buffer returned is also a dpr_mode_t structure with the error code in the mode_df.df_err element, which is zero on success. The elements in the IOCTLTSIMODE structure are:

INT32 index	The Connection index into the Connection MAP Matrix for this operation, if needed. The MAP Element associated with this index will have its mode value updated to reflect the current mode of operation. The index has a valid range of -1 to MAX_CONNECTIONS -1. A value of -1 performs the operation but does not update the mode value in the MAP structure. The index for a particular connection may be determined with the DPR_IS_TXCONNECTED and DPR_IS_RXCONNECTED commands.
UINT32 uiTSIMode	The particular sub-mode operation being carried out by the TSI. Valid sub-mode values for the DPR_MODE operation are TTSI_LOWLAT, TTSI_FRAMEI, and TTSI_TRISTATE.
UINT32 uiRxStream	The Receive Stream/TSI Highway Number with a valid range of 0 to 31.
UINT32 uiTxStream	The Transmit Stream/TSI Highway Number with a valid range of 0 to 31.
UINT32 uiRxTimeslot	The Receive Time Slot Number with a valid range of 0 to 127.
UINT32 uiTxTimeslot	The Transmit Time Slot Number with a valid range of 0 to 127.
UINT32 uiArg	The use of this element varies by command. It is unused by the DPR_MODE command.

DPR_HOST_DATA. Tells the TSI to transmit the supplied data repeatedly.

The putmsg control buffer is a structure of type dpr_mode_t with the mode_tsi element a IOCTLTSIMODE structure that specifies the host data. The getmsg control buffer returned is also a dpr_mode_t structure with the error code in the mode_df.df_err element, which is zero on success. The elements in the IOCTLTSIMODE are:

INT32 index	The Connection index into the Connection MAP Matrix for this operation, if needed. (See DPR_MODE)
UINT32 uiTSIMode	Must contain the value TTSI_HOST.
UINT32 uiRxStream	Ignored

UINT32 uiTxStream	The Transmit Stream/TSI Highway Number with a valid range of 0 to 31.
UINT32 uiRxTimeslot	The Host Data to be sent out over the connection.
UINT32 uiTxTimeslot	IgnoredThe Transmit Time Slot Number with a valid range of 0 to 127. 0
UINT32 uiArg	Unused by the DPR_HOST command. _H

DPR_IDLE_CODE. Tells the TSI to operate in Idle Code substitution mode.

The putmsg control buffer is a structure of type dpr_mode_t with the mode_tsi element a IOCTLTSIMODE structure that specifies the idle code mode. The getmsg control buffer returned is also a dpr_mode_t structure with the error code in the mode_df.df_err element, which is zero on success. The elements in the IOCTLTSIMODE are described in *DPR_MODE* on page 110 except for:

uiTSIMode	Must be one of TTSI_IDLE1, TTSI_IDLE2, or TSSI_IDLE3.
uiRxStream	Ignored
uiRxTimeslot	Ignored

DPR_TEST_PATTERN. Tells the TSI to transmit ad receive test patterns.

The putmsg control buffer is a structure of type dpr_mode_t with the mode_tsi element a IOCTLTSIMODE structure that specifies the test pattern, which can be one of the predefined set of patterns included with the TSI, or can be user defined. The getmsg control buffer returned is also a dpr_mode_t structure with the error code in the mode_df.df_err element, which is zero on success.

The elements in the IOCTLTSIMODE are described in *DPR_MODE* on page 110 except for:

uiTSIMode Must be TTSI_TESTPAT.

uiRxStream Ignored.

uiRxTimeslot Ignored.

uiArg A value created using the macro SET_TEST_PATTERN (generate, start, style, pattern, rate) with the following arguments:

generate Set to 1 for the TTSI to generate the test pattern, 0 to receive.

start Set to 1 to start generation or reception, 0 to stop.

style Set to one of the following:

TSI_TP_MARK (0.151)	MARK (all 1's) (AIS red alarm)
TSI_TP_QRSS	QRSS (2**20-1 zero suppression) (0.151)
TSI_TP_31	31 (2**5-1) PRBS
TSI_TP_63	63 (2**6-1) PRBS
TSI_TP_511	511 (2**9-1) PRBS (0.153)
TSI_TP_511_RVSD	511 (2**9-1) PRBS (reversed)
TSI_TP_2047	2047 (2**11-1) PRBS (0.152)
TSI_TP_2047_RVSD	2047 (2**11-1) PRBS (reversed)
TSI_TP_2_TO_15	2**15-1 PRBS (0.151) (noninverted)
TSI_TP_2_TO_20	2**20-1 PRBS (0.153)
TSI_TP_2_TO_20_RSVD	2**20-1 PRBS (reversed)
TSI_TP_2_TO_23	2**31-1 PRBS (V.33) (noninverted)
TSI_TP_ONE_TO_ONE	1:1 (alternating 1s and 0s)
TSI_TP_RSVD_1	Reserved
TSI_TP_RSVD_2	Reserved
TSI_TP_USER	Fixed. User-defined byte

pattern The user defined test pattern byte. Ignored if the style is not TSI_TP_USER.

rate Set to one of the following:

TSI_TP_RATE_NONE	Idle, no transmission or reception.
TSI_TP_RATE_2Mb	2.048 Mbits/second
TSI_TP_RATE_4Mb	4.096 Mbits/second
TSI_TP_RATE_8Mb	8.192 Mbits/second

DPR_READ_DATA_STORE. Reads current incoming data byte in the TSI for the selected highway and time slot.

The putmsg control buffer is a structure of type dpr_data_t with the data_tsi element a IOCTLTSIDATASTORE structure that specifies the mode. The getmsg control buffer returned is also a dpr_data_t structure with the error code in the data_df.df_err element, which is zero on success. The data read will be in the element data_tsi.uiData. The elements in the IOCTLTSIDATASTORE structure are:

UINT32 uiRxHighway	The Receive Highway Number.
UINT32 uiRxTimeSlot	The Receive Time Slot Number.
UINT32 uiData	The current data returned from the TSI.

DPR_CTBUS_ENABLE. Enables the H.110 bus for clocking and data transmission.

The putmsg control buffer is a structure of type dpr_func_t, which contains only the command. The getmsg control buffer returned is also a dpr_func_t structure with the error code in the df_err element, which is zero on success.

DPR_CTBUS_DISABLE. Disables the H.110 bus for clocking and data transmission.

The putmsg control buffer is a structure of type dpr_func_t, which contains only the command. The getmsg control buffer returned is also a dpr_func_t structure with the error code in the df_err element, which is zero on success.

DPR_TTSI_LOOPBACK. Sets the loopback mode for the TSI.

The putmsg control buffer is a structure of type dpr_usel_t with the usel_val element containing the TSI loopback mode desired. The getmsg control buffer returned is also a dpr_usel_t structure with the error code in the usel_err element, which is zero on success. The loopback mode are:

ALL	Put the TSI in loopback mode for all streams.
ALL_COMETS	Put the TSI in loopback mode for all COMET streams.
ALL_TS70X	Put the TSI in loopback mode for all TS704 streams.
ALL_H110	Put the TSI in loopback mode for all H.110/CT bus streams.
0	Take the TSI out of loopback mode for all streams.

DPR_CONN_RPT. Gets a report of the connections.

The putmsg control buffer is a structure of type dpr_func_t, which contains only the command. The getmsg control buffer returned is also a dpr_func_t structure with the error code in the df_err element, which is zero on success. The text strings for the report are returned in the data buffer. It may take several getmsg calls to get all of the data as shown in the following example:

```
char buf[512];      /* print buffer */
int err;            /* err code */
int flag;     /* flag, set to non-priority msg */
int more;    /* more data flag */
struct strbuf prctl; /* structure for control part of msg */
struct strbuf prdata; /* structure for data part of msg */
dpr_func_t prproto; /* request/response control structure */
/*
* Set up the DPR_CONN_RPT command and send it to the board.
*/
prproto.df_fun = (DPR_PROTO_CODE << 8) | DPR_CONN_RPT;
prctl.maxlen = sizeof (prproto);
prctl.len = sizeof (prproto);
prctl.buf = (char *)&prproto;
if (!(err = putmsg (fd, &prctl, 0, 0))) {
       /*
       * Get response from the board and output to stdout.
       */
       do {
              prctl.maxlen = sizeof (prproto);
              prctl.len = 0;
              prctl.buf = (char *)&prproto;
              prdata.maxlen = sizeof (buf);
              prdata.len = 0;
              prdata.buf = buf;
              flag = 0;
              more = getmsg (fd, &prctl, &prdata, &flag);
              /*
               * Quit on a getmsg error.
               */
              if (more < 0) {
                     err = more;
                     break;
              }
              /*
              * Retain any error returned.
              */
              if (prctl.len)
                     err = prproto.df_err;
              /*
               * Print out all data received.
               */
              fwrite (buf, prdata.len, 1, stdout);
       }while (more) ;
}
```

DPR_HWY_RPT. Gets a report of the time slot assignments for the specified highway.

The putmsg control buffer is a structure of type dpr_usel_t with the usel_val element the number of the specified highway. The getmsg control buffer returned is also a dpr_usel_t structure with the error code in the usel_err element, which is zero on success. The report is returned in the same way as for DPR_CONN_RPT.

DPR_PRINT_MATRIX. Gets a combined report of the connections and the time slot assignments for the specified highway.

The putmsg control buffer is a structure of type dpr_usel_t with the usel_val element the number of the specified highway. The getmsg control buffer returned is also a dpr_usel_t structure with the error code in the usel_err element, which is zero on success. The report is returned in the same way as for DPR_CONN_RPT.

DPR_CFG_DEFAULT. Resets the DPR configuration to the default.

The putmsg control buffer is a structure of type dpr_func_t, which contains only the command. The getmsg control buffer returned is also a dpr_func_t structure with the error code in the df_err element, which is zero on success.

7-2. libdpr (3sbe)

libdpr provides a set of routines that allow an application to set up and dynamically control time slot connections and clocking operations on all HighWire boards. The DPR service included in the protocol modules downloaded to the HighWire board initializes the Data Path Routing matrix to a functional default configuration. This configuration may be changed by using the getmsg(2) and putmsg(2) Streams functions as described in Section 7-1, *dprservice (7D)*, or by using the routines defined in this chapter that are included in the shared object library libsbe.so.

For additional information on shared object interfaces, see intro(4). The features in this library are implemented upon dynamic linking.

To reference the online manpages, you may need to use the appropriate man(1) section.

Example:

```
man -s 3sbe sbe_dprOpen
```

Synopsis cc [**flag** ...] **file** ... -l/usr/include/sbe -lsbe -lsocket -lposix4

Availability Provided as a component of the SBE HighWire and LinkWARE Support Packages.

Routines

sbe_dprOpen	open a connection to the DPR service on the specified board
sbe_dprClose	close a connection to the DPR service
sbe_dprRead	read the current connection matrix
sbe_dprWrite	write the supplied connection matrix and make it the current one
sbe_dprIoctl	change individual connections and change various dynamic parameters
sbe_dprConfigDefault	set up the default DPR configuration on the board
sbe_dprConnectionReport	print the connection matrix
sbe_dprHighwayReport	print the time slot assignments for the highway
sbe_dprPrint	print the connection matrix and the time slot assignments for the highway

7-3. sbe_dprOpen

Using sbe_dataOpen(3X), this routine opens a connection to the DPR service on the specified board and returns a file descriptor for that connection. It is equivalent to sbe_dataOpen (DPR_SERVICE, Board, 0, oflags).

Allowed values for oflags are described in open(2).

Synopsis

```
#include <fcntl.h>
#include "sbe_dprlib.h"
int sbe_dprOpen (int Board, int oflags);
```

Return values On a successful open, sbe_dprOpen returns the number of the file descriptor for the opened connection. On an error, –1 is returned with errno as described in libsbe(3).

See also sbe_dataOpen(3X), libsbe(3), dprservice, open(2)

7-4. sbe_dprClose

sbe_dprClose closes the connection to the DPR service on the board and leaves the DPR configuration on the board as is. It is equivalent to close (fildes).

Synopsis

```
#include "sbe_dprlib.h"
int sbe_dprClose (int fildes);
```

Return values See close(2)

See also close(2)

7-5. sbe_dprRead

This routine issues a command to the DPR service to return up to nmaps of the current connection matrix. If nmaps is set to MAX_CONNECTIONS, all connection maps are read into the buffer buf.

Synopsis

```
#include "sbe_dprlib.h"
int sbe_dprRead (int fildes, MAP *buf, int nmaps);
```

Return values On a successful read, sbe_dprRead returns the number of connection maps read. On an error, if sbe_dprRead returns a –1, the global variable errno is set by getmsg or putmsg. Otherwise sbe_dprRead returns a negative error code as described in dprd_if.h or dpr/dpr_driver.h.

See also dprservice(7d), getmsg(2), putmsg(2)

7-6. sbe_dprWrite

This routine issues a command to the DPR service to clear out all existing connections and replace them with the number of connections and nmaps specified in the supplied matrix buf. Normally this is only done at system startup with most connections set up and torn down using the DPR_CONNECT and DPR_DISCONNECT commands.

Synopsis

```
#include "sbe_dprlib.h"
int sbe_dprWrite (int fildes, MAP *buf, int nmaps);
```

Return values

On a successful write, sbe_dprWrite returns the number of connection maps set. On an error, if sbe_dprWrite returns a −1, the global variable errno is set by getmsg or putmsg. Otherwise sbe_dprWrite returns a negative error code as described in dprd_if.h or dpr/dpr_driver.h.

See also

dprservice(7d), getmsg(2), putmsg(2)

7-7. sbe_dprIoctl

This routine issues the specified command cmd with argument arg to the DPR service. It waits for the response from the board and returns any data from the response to the memory pointed to by arg.

Synopsis

```
#include "sbe_dprlib.h"
int sbe_dprIoctl (int fildes, int cmd, void *arg);
```

Commands

Allowed commands with their arguments are:

DPR_CONNECT. Connects one time slot from a source to a destination.

Arg points to a MAP structure with the following elements:

UINT32 fromDev	Source time slot made up by using the macros PUT_TIMESLOT(t) | PUT_CHAN(c) | PUT_DEVICE(d)	
UINT32 toDev	Destination time slot made up by using the above macros.	
UINT32 mode	TSI transmission mode for connect as follows:	
	TTSI_LOWLAT	Low-latency mode
	TTSI_FRAMEI	Frame-integrity mode
	TTSI_HOST	Host data substitution mode
	TTSI_IDLE1	Put idle code1 on the TDM highway
	TTSI_IDLE2	Put idle code2 on the TDM highway
	TTSI_IDLE3	Put idle code3 on the TDM highway
	TTSI_TESTPAT	Put test pattern on the TDM highway
	TTSI_TRISTATE	Tri-state the TDM highway
INT32 connected	1 - TDM highway connection; 0 - disconnected; –1 - N/A	
UINT32 ct_xmit_enable	1 - enable; 0 - disable	
INT32 local_TSA_line	The local TSA TDM highway number (0-7) or –1 for N/A	

DPR_DISCONNECT. Disconnects connections according to the contents of arg.

Arg points to a MAP structure with the same elements as DPR_CONNECT. In this case the connected and ct_xmit_enable elements are not used and the mode element indicates the scope of the disconnect command as follows:

SPECIFIED	disconnect just the specified time slot from the source to the destination.
ALL	disconnect all connections.
ALL_H110	disconnect all H.110 bus connections.
ALL_COMETS	disconnect all Comet connections.
ALL_TS70X	disconnect all TS704 connections.

DPR_IS_TXCONNECTED. Checks the specified device, channel, and time slot for connections to a receiving device, channel, and time slot. If so, returns the destination device, channel and time slot. If not, the result index is set to –1. Note that a transmit time slot may be connected to multiple receiving time slots but only information on the first one found is returned.

Arg points to a IOCTLTXRXCONNECT structure with the following elements:

UINT32 uiDevice	Transmit device supplied.
UINT32 uiChannel	Transmit channel supplied.
UINT32 uiTimeslot	Transmit time slot supplied.
UINT32 uiOtherDevice	Receiving device returned if there is one.
UINT32 uiOtherChannel	Receiving channel returned if there is one.
UINT32 uiOtherTimeslot	Receiving time slot returned if there is one.
INT32 uiResultIndex	Index of first receiving end found or –1 if there is no destination connected.

DPR_IS_RXCONNECTED. Checks the specified device, channel and time slot to see if it is connected to a transmitting device, channel, and time slot. If so, returns the source device, channel, and time slot. If not, the result index is set to –1.

Arg points to a IOCTLTXRXCONNECT structure with the following elements:

UINT32 uiDevice	Receiving device supplied.
UINT32 uiChannel	Receiving channel supplied.
UINT32 uiTimeslot	Receiving time slot supplied.
UINT32 uiOtherDevice	Transmitting device returned if there is one.
UINT32 uiOtherChannel	Transmitting channel returned if there is one.
UINT32 uiOtherTimeslot	Transmitting time slot returned if there is one.
INT32 uiResultIndex	Index of transmitting end or –1 if there is no source connected.

DPR_PRIMARY_CLOCK. This command configures the H.110/CT bus primary clock to the specified source.

Arg points to an integer containing one of the following values:

T8100_CLK_INTERNAL	Run the primary clock from the internal oscillator.
T8100_CLK_FRAMEA	Run the primary clock from Frame A.
T8100_CLK_FRAMEB	Run the primary clock from Frame B.
T8100_CLK_NETREF1	Run the primary clock from External Net Reference 1.
T8100_CLK_NETREF2	Run the primary clock from External Net Reference 2.
T8100_CLK_LREF0	Run the primary clock from Local Reference 0.
T8100_CLK_LREF1.	Run the primary clock from Local Reference 1.
T8100_CLK_LREF2	Run the primary clock from Local Reference 2.
T8100_CLK_LREF3	Run the primary clock from Local Reference 3.
T8100_CLK_LREF4	Run the primary clock from Local Reference 4.
T8100_CLK_LREF5	Run the primary clock from Local Reference 5.
T8100_CLK_LREF6	Run the primary clock from Local Reference 6.
T8100_CLK_LREF7	Run the primary clock from Local Reference 7.

DPR_FALLBACK_CLOCK. This command configures the H.110/CT bus fallback or secondary clock to the specified source.

Arg points to an integer containing one of the values listed below. Note that LREF0 and LREF4 through LREF7 are available only as the primary clock. The secondary clock must be different from the primary clock or an error results.

T8100_CLK_INTERNAL	Run the secondary clock from the internal oscillator.
T8100_CLK_FRAMEA	Run the secondary clock from Frame A.
T8100_CLK_FRAMEB	Run the secondary clock from Frame B
T8100_CLK_NETREF1	Run the secondary clock from External Net Reference 1.
T8100_CLK_NETREF2	Run the secondary clock from External Net Reference 2.
T8100_CLK_LREF1	Run the secondary clock from Local Reference 1.
T8100_CLK_LREF2	Run the secondary clock from Local Reference 2.
T8100_CLK_LREF3	Run the secondary clock from Local Reference 3.

DPR_BUS_CLOCK. This command selects a T8100 clock source to drive the local bus.

Arg points to an integer containing one of the values listed below.

T8100_CT_BUS_NO_CLK	Do not drive the local bus clock.
T8100_CT_BUS_CLK_A	Clock A to drive the local bus.
T8100_CT_BUS_CLK_B	Clock B to drive the local bus.
T8100_CT_BUS_CLK_AB	Clock A and B to drive the local bus.

DPR_BUS_NETREF. This command selects a T8100 clock source for the NETREF signal.

Arg points to an integer containing the NETREF assigned to the CT Bus and the source of the NETREF clock. Both values are packed into the integer value using the macro SET_NETREF (assign, source). The sources for the NETREF signal are:

T8100_CT_BUS_NO_NETREF	No NETREF assigned to CT Bus.
T8100_CT_BUS_NETREF_1	NETREF1 assigned to CT Bus.
T8100_CT_BUS_NETREF_2	NETREF2 assigned to CT Bus.
T8100_CT_BUS_NETREF_12	Both NETREF1 and NETREF2 assigned to CT Bus.

The values for NETREF sources are:

T8100_CT_BUS_NETREF_SRC_OSC_8	Internal oscillator divided by 8.
T8100_CT_BUS_NETREF_SRC_OSC	Internal oscillator.
T8100_CT_BUS_NETREF_SRC_NETREF_1	Select NETREF1 as input.
T8100_CT_BUS_NETREF_SRC_NETREF_2	Select NETREF2 as input.
T8100_CT_BUS_NETREF_SRC_LREF0	Comet 0 (Local Reference).
T8100_CT_BUS_NETREF_SRC_LREF1	Comet 1 (Local Reference).
T8100_CT_BUS_NETREF_SRC_LREF2	Comet 2 (Local Reference).
T8100_CT_BUS_NETREF_SRC_LREF3	Comet 3 (Local Reference).
T8100_CT_BUS_NETREF_SRC_LREF4	Comet 4 (Local Reference).
T8100_CT_BUS_NETREF_SRC_LREF5	Comet 5 (Local Reference).
T8100_CT_BUS_NETREF_SRC_LREF6	Comet 6 (Local Reference).
T8100_CT_BUS_NETREF_SRC_LREF7	Comet 7 (Local Reference).

DPR_CLOCK_DIVISOR. This command selects the divisor for the main clock, NETREFs, or resource divider.

Arg points to an integer containing the clock divider selected and the desired divisor. Both values are packed into the integer value using the macro SET_NETREF (divider, divisor). The divisor may be any value from 0 to 255. The possible clock divider selections are:

T8100_CLOCK_DIVIDER_MAIN	Main Clock Divider
T8100_CLOCK_DIVIDER_NETREF	NETREF Divider
T8100_CLOCK_DIVIDER_RESOURCE	Resource Divider

DPR_CLR_CLKERR. This command clears the clock error watchdogs in the T8102. It is recommended that it be used prior to enabling any new clock error watchdogs.

No argument is required, so the value of arg should be zero.

DPR_ENABLE_CLKERR_CALLBACK. This command enables the specified clock error watchdogs in the T8102 and causes the board to send unsolicited clock error messages to the application on the fildes Stream. The application must either periodically perform non-blocking getmsg(2) calls or set up a task to receive these unsolicited messages. Note that either a DPR_DISABLE_CLKERR_CALLBACK command or a close should be the only DPR actions after issuing this command.

Arg points to a CLKERROREVENT structure. Only the clkWdogMask and err3Data elements are used with this command. The elements in the structure are:

UINT32 clkWdogMask	CKW mask for what errors to enable: i.e. CKW_NETREF.
UINT32 errSource	error source: CLKERR1, CLKERR2, CLKERR3 or SYSERR.
UINT32 err1Data	error reason for CLKERR1.
UINT32 err2Data	error reason for CLKERR2.
UINT32 err3Data	error reason for CLKERR3; set bit 0 to enable NETREF2 error reporting.
UINT32 sysErrData	error reason for sysErr.

DPR_DISABLE_CLKERR_CALLBACK. This command disables the clock error watchdogs in the T8102 and stops the board from sending unsolicited clock error messages to the application.

No argument is required, so the value of arg should be zero.

DPR_GET_CLOCK_INFO. This command retrieves the current contents of selected clocking registers in the T8102.

Arg points to a T8100_CLOCK_INFO structure with the following elements:

UINT8 ckm	Master Clock Register.
UINT8 ckn	NETREF Selection Register.
UINT8 ckp	Programmable Outputs Register.
UINT8 ckr	Clock Resource Selection Register.
UINT8 cks	Secondary/Fallback Clock Register.
UINT8 ck32	Local Clocks 2 and 3 Source Selection Register.
UINT8 ckmd	Local Clocks 0 and 1 Source Selection Register.
UINT8 cknd	Main Clock Source Divider Register.
UINT8 ckrd	Resource Divider Register.

DPR_SET_CLOCK_INFO. This command sets the current contents of selected clocking registers in the T8102.

Arg points to a T8100_CLOCK_INFO.

DPR_DATA_ALIGNMENT. When there is a change in the Primary Clock, any data subsequently transferred must be re-aligned to the new clock value. This command determines the manner in which this re-alignment takes place.

Arg points to an integer containing one of the following data alignment values:

T8100_PHASE_ALIGN_NONE	The incoming frame is frequency locked to an inbound frame, but not phase aligned.
T8100_PHASE_ALIGN_SNAP	Instantaneous phase alignment at the frame boundary.
T8100_PHASE_ALIGN_SLIDE	A fraction of a bit time is removed from each frame until sync is achieved.

DPR_MODE. The mode of operation for the Time Slot Interchanger (TSI) can be altered, and mode changes not requiring additional user parameters can be invoked via this command. The mode changes that do not require additional user parameters, aside from the base mode change parameters, are:

- Low-Latency (TTSI_LOWLAT)
- Frame-Integrity (TTSI_FRAMEI)
- Tri-State/High-Impedance (TTSI_TRISTATE)

Arg points to a IOCTLTSIMODE structure with the following elements:

INT32 index	The Connection index into the Connection MAP Matrix for this operation, if needed. The MAP Element associated with this index will have its mode value updated to reflect the current mode of operation. The index is a signed 32-bit integer and has a valid range of −1 to MAX_CONNECTIONS −1. A value of −1 performs the operation but does not update the mode value in the MAP structure. The index for a particular connection may be determined with the DPR_IS_TXCONNECTED and DPR_IS_RXCONNECTED commands.
UINT32 uiTSIMode	The particular sub-mode operation being carried out by the TSI. Valid sub-mode values for the DPR_MODE operation are TTSI_LOWLAT, TTSI_FRAMEI and TTSI_TRISTATE.
UINT32 uiRxStream	The Receive Stream/TSI Highway Number. It is an unsigned 32-bit integer with a valid value range of 0 to 31.
UINT32 uiTxStream	The Transmit Stream/TSI Highway Number. It is an unsigned 32-bit integer with a valid value range of 0 to 31.
UINT32 uiRxTimeslot	The Receive Time Slot Number. It is an unsigned 32-bit integer with a valid value range of 0 to 127.
UINT32 uiTxTimeslot	The Transmit Time Slot Number. It is an unsigned 32-bit integer with a valid value range of 0 to 127.
UINT32 uiArg	The use of this element varies by command. It is unused by the DPR_MODE command.

DPR_HOST_DATA. This command causes the TSI to transmit the supplied data repeatedly. Arg points to a IOCTLTSIMODE structure as described in *DPR_MODE* except for:

uiTSIMode	Must contain the value TTSI_HOST.
usRxTimeslot	The Host Data to be sent out over the connection.
uiRxStream	Ignored.

DPR_IDLE_CODE. This command causes the TSI to operate in Idle Code substitution mode. Arg points to a IOCTLTSIMODE structure as described in *DPR_MODE* except for:

uiTSIMode	Must be one of TTSI_IDLE1, TTSI_IDLE2, or TSSI_IDLE3.
usRxTimeslot	Ignored.
uiRxStream	Ignored.

DPR_TEST_PATTERN. This command causes the TSI to transmit and receive test patterns, which can be one of the predefined set of patterns included with the TSI, or it can be user defined. Arg points to a IOCTLTSIMODE structure as described in *DPR_MODE* except for:

uiTSIMode	Must be TTSI_TESTPAT.
usRxTimeslot	Ignored.
uiRxStream	Ignored.
uiArg	A value created using the macro SET_TEST_PATTERN (generate, start, style, pattern, rate) with the following arguments:

generate	Set to 1 for the TTSI to generate the test pattern, 0 to receive.	
start	Set to 1 to start generation or reception, 0 to stop.	
style	Set to one of the following:	
	TSI_TP_MARK (0.151)	MARK (all 1's) (AIS red alarm)
	TSI_TP_QRSS	QRSS (2**20-1 zero suppression) (0.151)
	TSI_TP_31	31 (2**5-1) PRBS
	TSI_TP_63	63 (2**6-1) PRBS
	TSI_TP_511	511 (2**9-1) PRBS (0.153)
	TSI_TP_511_RVSD	511 (2**9-1) PRBS (reversed)
	TSI_TP_2047	2047 (2**11-1) PRBS (0.152)
	TSI_TP_2047_RVSD	2047 (2**11-1) PRBS (reversed)
	TSI_TP_2_TO_15	2**15-1 PRBS (0.151) (noninverted)
	TSI_TP_2_TO_20	2**20-1 PRBS (0.153)
	TSI_TP_2_TO_20_RSVD	2**20-1 PRBS (reversed)
	TSI_TP_2_TO_23	2**31-1 PRBS (V.33) (noninverted)
	TSI_TP_ONE_TO_ONE	1:1 (alternating 1s and 0s)
	TSI_TP_RSVD_1	Reserved
	TSI_TP_RSVD_2	Reserved
	TSI_TP_USER	Fixed. User-defined byte
pattern	The user defined test pattern byte. Ignored if the style if not TSI_TP_USER.	
rate	Set to one of the following:	
	TSI_TP_RATE_NONE	Idle, no transmission or reception
	TSI_TP_RATE_2Mb	2.048 Mbits/second
	TSI_TP_RATE_4Mb	4.096 Mbits/second
	TSI_TP_RATE_8Mb	8.192 Mbits/second

DPR_READ_DATA_STORE. This command returns the current incoming data byte in the TSI for the selected highway and time slot.

Arg points to a IOCTLTSIDATASTORE structure with the following elements:

UINT32 uiRxHighway	The Receive Highway Number.
UINT32 uiRxTimeSlot	The Receive Time Slot Number.
UINT32 uiData	The current data returned from the TSI.

DPR_CTBUS_ENABLE. This command enables the H.110 bus for clocking and data transmission. No argument is required, so the value of arg should be zero.

DPR_CTBUS_DISABLE. This command disables the H.110 bus for clocking and data transmission. No argument is required, so the value of arg should be zero.

DPR_TTSI_LOOPBACK. This command either puts the TSI in loopback mode for the selected set of streams or takes it out of loopback mode for all streams. When in loopback, data will **still** be received by the side of the connection in which the loopback has segregated. However, the looped data will also appear back at the data's origin.

Arg is not a pointer but instead contains one of the following values:

ALL	Put the TSI in loopback mode for all streams.
ALL_COMETS	Put the TSI in loopback mode for all COMET streams.
ALL_TS70X	Put the TSI in loopback mode for all TS704 streams.
ALL_H110	Put the TSI in loopback mode for all H.110/CT bus streams.
0	Take the TSI out of loopback mode for all streams.

Return values On a successful command, sbe_dprIoctl returns a 0. It returns –1 on an error detected by getmsg or putmsg, which sets the global variable errno as appropriate. Otherwise sbe_dprIoctl returns an error code as described in dprd_if.h or dpr/dpr_driver.h.

See also dprservice(7d), getmsg(2), putmsg(2)

7-8. sbe_dprConfigDefault

This routine sends a command to the board to reset its configuration to the default set at startup.

Synopsis

```
#include "sbe_dprlib.h"
int sbe_dprConfigDefault (int fildes);
```

Return values On a successful resetting of the DPR configuration, sbe_dprConfigDefault returns a 0. It returns –1 on an error detected by getmsg or putmsg, which sets the global variable errno as appropriate. Otherwise sbe_dprConfigDefault returns an error code as described in dprd_if.h or dpr/dpr_driver.h.

See also dprservice(7d), getmsg(2), putmsg(2)

7-9. sbe_dprConnectionReport

This routine sends a command to the board to send up text describing the current connection matrix, which is then printed to standard out.

Synopsis

```
#include "sbe_dprlib.h"
int sbe_dprConnectionReport (int fildes);
```

Return values On a successful printing of the connections, sbe_dprConnectionReport returns a 0. It returns –1 on an error detected by getmsg or putmsg, which sets the global variable errno as appropriate. Otherwise sbe_dprConnectionReport returns an error code as described in dprd_if.h or dpr/dpr_driver.h.

See also dprservice (7d), getmsg(2), putmsg(2)

7-10. sbe_dprHighwayReport

This routine sends a command to the board to send up text describing the time slots assigned for the supplied highway hwy, which is then printed to standard out.

Synopsis

```
#include "sbe_dprlib.h"
int sbe_dprHighwayReport (int fildes, int hwy);
```

Return values On a successful printing of the time slot assignments, sbe_dprHighwayReport returns a 0. It returns –1 on an error detected by getmsg or putmsg, which sets the global variable errno as appropriate. Otherwise sbe_dprHighwayReport returns an error code as described in dprd_if.h or dpr/dpr_driver.h.

See also dprservice(7d), getmsg(2), putmsg(2)

7-11. sbe_dprPrint

This routine combines the functions of sbe_dprConnectionReport and sbe_dprHighwayReport by sending a command to the board which then returns text describing both the current connection matrix and the time slots assigned for the supplied highway hwy. This is then printed to standard out.

Synopsis

```
#include "sbe_dprlib.h"
int sbe_dprPrint (int fildes, int hwy);
```

Return values

On a successful printing, sbe_dprPrint returns 0. It returns –1 on an error detected by getmsg or putmsg, which sets the global variable errno as appropriate. Otherwise sbe_dprPrint returns an error code as described in dprd_if.h or dpr/dpr_driver.h.

See also

dprservice (7d), getmsg(2), putmsg(2)

8. Appendix A: Test and Library Files

8-1. CBI Files

The CBI files listed in the following subsections will be installed to /opt/SBEhw/src/cbiptest during the package installation.

8-1-1. CBI library source files (for Solaris)

The HighWire_MTP2 release includes the following CBI library source files:

- cbiapi.c
- cbidclt.c
- cbihandl.c
- cbimon.c
- cbitctl.c
- cbitrace.c

8-1-2. CBI include files (for Solaris)

The HighWire_MTP2 release includes the following CBI include files for Solaris:

- cbi.h
- cbiint.h
- cbim2.h
- cbicssif.h
- cbiptest.h

8-1-3. CBI include files (for SDK)

The HighWire_MTP2 release includes the following CBI include files for SDK:

- cbi.h
- cbim2.h
- cbicssif.h

8-1-4. CBIPTEST program (for Solaris)

The HighWire_MTP2 release includes the following CBIPTEST program source files:

- cbipmake.c
- cbiprecv.c
- cbipsend.c
- cbiptest.c

8-1-5. Utility files

The HighWire_MTP2 release includes the following utility file:

- Makefile

8-1-6. cbiDemo program

- cbiDemo.c
- cbiDemo.h

8-2. Compiling the CBIPTEST Program

To compile the CBITEST program, you may have to modify the Makefile for your local environment and C compiler. Then follow these steps:

```
cd /opt/SBEhw/src/cbiptest
make clobber
make
```

8-3. Running the CBIPTEST Program

The executables will be stored in ./obj/libcbi.so (library) and ./cbiptest (the test program). Copy the two executables to where they are to be run, if not on this machine.

Set the location from which the library routines will be located by setting an environment variable with the command:

```
setenv LD_LIBRARY_PATH .
```

After making sure that a loopback cable is installed between ports 0 and 1 on the SBE HW400 board, and the board and download module are freshly restarted, execute the test program:

cbiptest <device><framing><clocking><ports><timeslots><delay>

where:

<device>=the device name of the MPT2 device on the HW400. For example, /dev/hw0_mtp2_0 is a device on board 0, /dev/hw1_mtp2_0 is a device on board 1, etc.

<framing>=framing option, either T1 or E1

<clocking>=Tx clock sourcing option for the framing. Allowed values are:
LOCAL—drive the TCLK from local oscillator
LOOP—derive from Rx clock
THROUGH—TBD

<ports>=the number of ports to be used in the test (2 is suggested)

<timeslots>=the number of DS0 timeslots to be used; 1–23 on T1, or 1–31 on E1

<delay>=a delay value in milliseconds. Suggested value is 50. The value 0 means that it will automatically determine the delay and adjust while the test is running.

Example:

cbiptest /dev/hw0_mtp2_0 E1 LOCAL 2 1 50
to test HW board 0, with E1 framing, Tx clock sourcing set to local, two ports, one timeslot each, and a delay of 50ms

8-4. Compiling the cbiDemo Program under SDK

1. Copy cbiDemo.c from the distribution to:
   w:\vxworks\vxhw400\cust_demo
2. Copy cbiDemo.h from the distribution to:
   w:\common\include\cbi
3. Under the Tornado 2 VxWorks development workspace **hw400_sdk_src**, add cbiDemo.c to the **sdk_sample_applications** build.
   w:\vxworks\vxhw400\cust_demo\cbiDemo.c
4. Under the **sdk_sample_applications** build, **C/C+ compiler** tab, add defines:
   -DINC_DPR -DSABRE_NBASE -DHWMTP2_FOR_SDK
5. Generate/resolve dependencies.
6. Rebuild all.

8-5. Running the cbiDemo Program under SDK

1. The executable will be stored in:

w:\vxworks\projects\sdk_sample_applications\PPC603GNU\cbiDemo.o

2. Download the executable to the target HW400 system
3. At the VxWorks windshell, type:
   sp cbiDemo , 0,1 (single master target)
4. If a second system is desired, type:
   sp cbiDemo , 0,0 (slave target)

8-6. Compiling cbiDemo Program under Solaris

See Chapter 11, *Appendix: cbiDemo.c and dprDemo.c*, for recompilation information.

8-7. Running the cbiDemo Program under Solaris

1. Change directories to /opt/SBehw/bin
2. Type ./cbiDemo <board number> <mode>

8-8. CBIPTEST Program Console Printout

Below is a sample console printout from the CBITEST program.

```
Device name is /dev/hw2_mtp2_0
Testing E1 on device /dev/hw2_mtp2_0, ports 0-1, timeslots 1-1
cbiptest: cbiptest_init
cbiptest: cbiptest_performance
Calling cbi_initialize...
Opening the fifo, name=CBIFIFO1563 result=4
Check expected return code
opened /dev/hw2_mtp2_0 3
Send CBI_M2_OPEN
send opened
```

```
Wait for CBI_M2_OPEN
Other msg available, ips_type=0x18800025, ctrl_size=84,
data_size=0
Got CBI_M2_OPEN
Received CBI_M2_OPEN
recv opened
Send CBI_M2_REGISTER[0,1]
Wait for CBI_M2_REGISTER[0,1]
Other msg available, ips_type=0x18800001, ctrl_size=92,
data_size=0
Timeslot[1] sender_handle=0x11a0000, receiver_handle=0x1
Received CBI_M2_REGISTER[0,1]
Wait for CBI_M2_AVAILABLE[0,1]
Other msg available, ips_type=0x18800003, ctrl_size=48,
data_size=0
Received CBI_M2_AVAILABLE[0,1]
Send CBI_M2_UPDATE_PARMS[0,1]
Wait for CBI_M2_UPDATE_PARMS[0,1]
Other msg available, ips_type=0x18800008, ctrl_size=344,
data_size=0
Received CBI_M2_UPDATE_PARMS[0,1]
Send CBI_M2_UPDATE_PARMS[0,1]
Wait for CBI_M2_UPDATE_PARMS[0,1]
Other msg available, ips_type=0x18800008, ctrl_size=344,
data_size=0
Received CBI_M2_UPDATE_PARMS[0,1]
Send CBI_M2_REGISTER[1,1]
Wait for CBI_M2_REGISTER[1,1]
Other msg available, ips_type=0x18800001, ctrl_size=92,
data_size=0
Timeslot[1] sender_handle=0x1440000, receiver_handle=0x10001
Received CBI_M2_REGISTER[1,1]
Wait for CBI_M2_AVAILABLE[1,1]
Other msg available, ips_type=0x18800003, ctrl_size=48,
data_size=0
Received CBI_M2_AVAILABLE[1,1]
Send CBI_M2_UPDATE_PARMS[1,1]
Wait for CBI_M2_UPDATE_PARMS[1,1]
Other msg available, ips_type=0x18800008, ctrl_size=344,
data_size=0
Received CBI_M2_UPDATE_PARMS[1,1]
Send CBI_M2_UPDATE_PARMS[1,1]
Wait for CBI_M2_UPDATE_PARMS[1,1]
Other msg available, ips_type=0x18800008, ctrl_size=344,
data_size=0
Received CBI_M2_UPDATE_PARMS[1,1]
Send CBI_M2_START[0,1]
Send CBI_M2_START[1,1]
Wait for CBI_M2_IN_SERVICE
Other msg available, ips_type=0x18800014, ctrl_size=48,
data_size=0
Received CBI_M2_IN_SERVICE[0,1]
Wait for CBI_M2_IN_SERVICE
```

```
Other msg available, ips_type=0x18800014, ctrl_size=48,
data_size=0
Received CBI_M2_IN_SERVICE[1,1]
1 timeslots, 0.48 seconds, 5000 bytes, 100 data messages
1 timeslots, 2.68 seconds, 10000 bytes, 200 data messages
1 timeslots, 0.60 seconds, 15000 bytes, 300 data messages
1 timeslots, 2.84 seconds, 20000 bytes, 400 data messages
1 timeslots, 0.78 seconds, 25000 bytes, 500 data messages
1 timeslots, 3.06 seconds, 30000 bytes, 600 data messages
1 timeslots, 0.86 seconds, 35000 bytes, 700 data messages
1 timeslots, 3.07 seconds, 40000 bytes, 800 data messages
1 timeslots, 1.09 seconds, 45000 bytes, 900 data messages
1 timeslots, 3.29 seconds, 50000 bytes, 1000 data messages
1 timeslots, 1.18 seconds, 55000 bytes, 1100 data messages
1 timeslots, 3.39 seconds, 60000 bytes, 1200 data messages

etc.
```

8-9. cbiDemo Program Console Printout

This sample output is for a dual board connection running 2 DS1 ports and 31 DS0s per port.

```
-> sp cbiDemo, 0,1 /* (master board) */
-> sp cbiDemo, 0,0 /* (slave board) */
CBI Demo Running...
CBI Library initialized!
DPR: Master Device: Synced to Internal Clock
OpenInterface: Master Device:Local Transmit Clock.
OpenInterface: Master Device:Local Transmit Clock.
OpenInterface: Master Device:Local Transmit Clock.
OpenInterface: Master Device:Local Transmit Clock.
OpenInterface: Master Device:Local Transmit Clock.
OpenInterface: Master Device:Local Transmit Clock.
OpenInterface: Master Device:Local Transmit Clock.
OpenInterface: Master Device:Local Transmit Clock.
MetaSwitch Port 10001 declared Up
MetaSwitch Port 10008 declared Up
MetaSwitch Port 10007 declared Up
MetaSwitch Port 10006 declared Up
MetaSwitch Port 10005 declared Up
MetaSwitch Port 10004 declared Up
MetaSwitch Port 10003 declared Up
MetaSwitch Port 10002 declared Up
Port 8 Channel 1 IN_SERVICE!!
Port 8 Channel 2 IN_SERVICE!!
Port 8 Channel 3 IN_SERVICE!!
Port 8 Channel 4 IN_SERVICE!!
Port 8 Channel 5 IN_SERVICE!!
Port 8 Channel 6 IN_SERVICE!!
Port 8 Channel 7 IN_SERVICE!!
Port 8 Channel 8 IN_SERVICE!!
Port 8 Channel 9 IN_SERVICE!!
```

```
Port 8 Channel 10 IN_SERVICE!!
Port 8 Channel 11 IN_SERVICE!!
Port 8 Channel 12 IN_SERVICE!!
Port 8 Channel 13 IN_SERVICE!!
Port 8 Channel 14 IN_SERVICE!!
Port 8 Channel 15 IN_SERVICE!!
Port 8 Channel 16 IN_SERVICE!!
Port 8 Channel 17 IN_SERVICE!!
Port 8 Channel 18 IN_SERVICE!!
Port 8 Channel 19 IN_SERVICE!!
Port 8 Channel 20 IN_SERVICE!!
Port 8 Channel 21 IN_SERVICE!!
Port 8 Channel 22 IN_SERVICE!!
Port 8 Channel 23 IN_SERVICE!!
Port 8 Channel 24 IN_SERVICE!!
Port 8 Channel 25 IN_SERVICE!!
Port 8 Channel 26 IN_SERVICE!!
Port 8 Channel 27 IN_SERVICE!!
Port 8 Channel 28 IN_SERVICE!!
Port 8 Channel 29 IN_SERVICE!!
Port 8 Channel 30 IN_SERVICE!!
Port 8 Channel 31 IN_SERVICE!!
Port 9 Channel 1 IN_SERVICE!!
Port 9 Channel 2 IN_SERVICE!!
Port 9 Channel 3 IN_SERVICE!!
Port 9 Channel 4 IN_SERVICE!!
Port 9 Channel 5 IN_SERVICE!!
Port 9 Channel 6 IN_SERVICE!!
Port 9 Channel 7 IN_SERVICE!!
Port 9 Channel 8 IN_SERVICE!!
Port 9 Channel 9 IN_SERVICE!!
Port 9 Channel 10 IN_SERVICE!!
Port 9 Channel 11 IN_SERVICE!!
Port 9 Channel 12 IN_SERVICE!!
Port 9 Channel 13 IN_SERVICE!!
Port 9 Channel 14 IN_SERVICE!!
Port 9 Channel 15 IN_SERVICE!!
Port 9 Channel 16 IN_SERVICE!!
Port 9 Channel 17 IN_SERVICE!!
Port 9 Channel 18 IN_SERVICE!!
Port 9 Channel 19 IN_SERVICE!!
Port 9 Channel 20 IN_SERVICE!!
Port 9 Channel 21 IN_SERVICE!!
Port 9 Channel 22 IN_SERVICE!!
Port 9 Channel 23 IN_SERVICE!!
Port 9 Channel 24 IN_SERVICE!!
Port 9 Channel 25 IN_SERVICE!!
Port 9 Channel 26 IN_SERVICE!!
Port 9 Channel 27 IN_SERVICE!!
Port 9 Channel 28 IN_SERVICE!!
Port 9 Channel 29 IN_SERVICE!!
Port 9 Channel 30 IN_SERVICE!!
Port 9 Channel 31 IN_SERVICE!!
--end output --
```

9. Appendix B: Code Values

This appendix contains the values assigned to control messages, data types, etc. for the Cross Bus Interface (CBI).

9-1. CBI Function Return Codes

These are the return codes from CBI interface functions. Do NOT confuse these with the return codes defined in the CBI_RETURN_CODES that are internal to the actual messages passed across the interface. These codes are relevant only to the Cross Bus Interface.

CBI Function Return Codes	Value
CBI_RC_SUCCESS	0
CBI_RC_INVALID	1
CBI_RC_IO_ERROR	2
CBI_RC_SYNC_COMPLETE	3
CBI_RC_ASYNC_COMPLETE	4
CBI_RC_UNINITIALIZED	5
CBI_RC_RESOURCE_FAILURE	6
CBI_RC_BUF_TOO_SMALL	7
CBI_RC_NO_MSG	8

9-2. CBI Return Codes

These are common return codes used on CBI IPSs that flow across the CBI.

CBI Return Codes	Value
CBI_OK	0
CBI_INVALID_TIMER_VALUES	1
CBI_RESOURCE_FAILURE	2
CBI_ABENDED	3
CBI_UNSUCCESSFUL	4
CBI_INVALID_QOS_VALUE	5
CBI_INVALID_STATE	6
CBI_INVALID_CONFIG	7
CBI_ASYNC_COMPLETION	8

9-3. CBI_YES_NO

Values for Yes and No.

CBI_YES_NO	Value
CBI_NO	0
CBI_YES	1

9-4. CBI_MTP2_IPS_TYPES

Command codes on messages which are sent from L3 to L2, and visa versa.

CBI_MTP2_IPS_TYPES	Value
IPS_CBI_M2_REGISTER	0x18800001
IPS_CBI_M2_UNREGISTER	0x18800002
IPS_CBI_M2_AVAILABLE	0x18800003
IPS_CBI_M2_UNAVAILABLE	0x18800004
IPS_CBI_M2_EV_REGISTER	0x18800005
IPS_CBI_M2_EV_UNREGISTER	0x18800006
IPS_CBI_M2_EV_INDICATION	0x18800007
IPS_CBI_M2_UPDATE_PARMS	0x18800008
IPS_CBI_M2_QUERY_CONFIG	0x18800009
IPS_CBI_M2_QUERY_STATUS	0x1880000A
IPS_CBI_M2_QUERY_STATS	0x1880000B
IPS_CBI_M2_LOC_PROCSSR_OUTAGE	0x1880000C
IPS_CBI_M2_LOC_PROCSSR_RECOVRD	0x1880000D
IPS_CBI_M2_LINK_CONGESTED	0x1880000E
IPS_CBI_M2_LINK_CONGSTN_CEASED	0x1880000F
IPS_CBI_M2_EMERGENCY	0x18800010
IPS_CBI_M2_EMERGENCY_CEASES	0x18800011
IPS_CBI_M2_START	0x18800012
IPS_CBI_M2_STOP	0x18800013
IPS_CBI_M2_IN_SERVICE	0x18800014
IPS_CBI_M2_OUT_OF_SERVICE	0x18800015
IPS_CBI_M2_FLUSH_BUFFERS	0x18800016
IPS_CBI_M2_CLEAR_RTB	0x18800017
IPS_CBI_M2_CONTINUE	0x18800018
IPS_CBI_M2_RETRIEVED_MESSAGE	0x18800019
IPS_CBI_M2_RETRIEVAL_COMPLETE	0x1880001A

CBI_MTP2_IPS_TYPES	Value
IPS_CBI_M2_RETRIEVAL_NOT_POSS	0x1880001B
IPS_CBI_M2_RETRIEVE_BSNT	0x1880001C
IPS_CBI_M2_BSNT	0x1880001D
IPS_CBI_M2_BSNT_NOT_RETRIEVABL	0x1880001E
IPS_CBI_M2_REM_PROCSSR_OUTAGE	0x1880001F
IPS_CBI_M2_REM_PROCSSR_RECOVRD	0x18800020
IPS_CBI_M2_RB_CLEARED	0x18800021
IPS_CBI_M2_RTB_CLEARED	0x18800022
IPS_CBI_M2_CREDIT	0x18800023
IPS_CBI_M2_CREDIT_ERROR	0x18800024
IPS_CBI_M2_OPEN	0x18800025
IPS_CBI_M2_CLOSE	0x18800026
	0x18810001
	0x18810002
IPS_CBI_M2_MSG_FOR_XMISSION	0x18810003
IPS_CBI_M2_RECEIVED_MESSAGE	0x18810004
IPS_CBI_M2_RETRIEVAL_REQ_FSNC	0x18810005

9-5. CBI_M2_MAJOR_VARIANT

Constants for the major variant states supported.

CBI_M2_MAJOR_VARIANT	Value
CBI_M2_MAJOR_VARIANT_ITU	0
CBI_M2_MAJOR_VARIANT_ANSI	1

9-6. CBI_M2_LPO_STATES

Constants for the local processor outage state reported across the Management Interface.

CBI_M2_LPO_STATES	Value
CBI_M2_LPO_RECOVERED	0x00
CBI_M2_LPO_OUTAGE	0x01

9-7. CBI_M2_UPS_TYPES

Constants for “User Proving State” requested by the L3.

CBI_M2_UPS_TYPES	Value
CBI_M2_UPS_NORMAL	0x00
CBI_M2_UPS_EMERGENCY	0x01

9-8. CBI_M2_PS_PROVING_TYPES

Constants for the current proving state in use by L2. It is reported on the Link Status indication.

CBI_M2_PS_PROVING_TYPES	Value
CBI_M2_PS_PROVING_NORMAL	0x00
CBI_M2_PS_PROVING_EMERGENCY	0x01

9-9. CBI_M2_EV_TYPES

Constants for indication types. See Section 6-3-11 for an explanation of event indications.

CBI_M2_EV_TYPES	Value
CBI_M2_EV_LINK_STATUS	0x00000001
CBI_M2_EV_SL_FAIL_ALL	0x00000002
CBI_M2_EV_SL_FAIL_FIBR_BSNR	0x00000004
CBI_M2_EV_SL_FAIL_NO_RSP	0x00000008
CBI_M2_EV_SL_FAIL_ERROR_RATE	0x00000010
CBI_M2_EV_SL_FAIL_CONG_DELAY	0x00000020
CBI_M2_EV_CONG_WITH_DISCARD_1	0x00000040
CBI_M2_EV_CONG_WITH_DISCARD_2	0x00000080
CBI_M2_EV_CONG_WITH_DISCARD_3	0x00000100
CBI_M2_EV_ALL_EVENTS	0x000001FF

9-10. CBI_M2_UPDATE_TYPES

Constants for M2_UPDATE_PARMS signal.

CBI_M2_UPDATE_TYPES	Value
CBI_M2_UPDATE_TEST	0x01
CBI_M2_UPDATE_SET	0x02
CBI_M2_UPDATE_CANCEL	0x03

9-11. CBI_M2_CONG_LEVELS

Constants for the congestion level in use by L2.

CBI_M2_CONG_LEVELS	Value
CBI_M2_CONG_NONE	0x00
CBI_M2_CONG_LEVEL_1	0x01
CBI_M2_CONG_LEVEL_2	0x02
CBI_M2_CONG_LEVEL_3	0x03

9-12. CBI_CONG_CTRL

Types of congestion handling.

CBI_CONG_CTRL	Value
CBI_CONG_CTRL_INTERNATIONAL	1
CBI_CONG_CTRL_NATL_WITH_PRI	2
CBI_CONG_CTRL_NATL_BUFFER	3
CBI_CONG_CTRL_NATL_TIMER	4

9-13. CBI_ERR_METHOD

Error method.

CBI_ERR_METHOD	Value
CBI_ERR_METHOD_BASIC	1
CBI_ERR_METHOD_PCR	2

9-14. CBI_XMIT_RATE

Transmission rate. Note that CBI_XMIT_RATE_MBITS1_5 is used to denote 1.5 Mbit/s for ITU and 1.536 Mbit/s for ANSI.

CBI_XMIT_RATE	Value
CBI_XMIT_RATE_KBITS4P8	1
CBI_XMIT_RATE_KBITS56	2
CBI_XMIT_RATE_KBITS64	3
CBI_XMIT_RATE_MBITS1_5	4
CBI_XMIT_RATE_MBITS2_0	5

9-15. CBI_IN_SERVICE_MONITOR_TYPES

CBI_IN_SERVICE_MONITOR_TYPES	Value
CBI_IN_SERVICE_SUERM	1
CBI_IN_SERVICE_EIM	2

9-16. CBI_M2_LINK_STATUS

Constants for the link status reported on the M2_QUERY_STATUS response and the M2_EV_SL_STATUS indication.

CBI_M2_LINK_STATUS	Value
CBI_M2_LINK_OUT_OF_SERVICE	0x00
CBI_M2_LINK_ALIGNING	0x01
CBI_M2_LINK_PROVING	0x02
CBI_M2_LINK_ALIGNED	0x03
CBI_M2_LINK_IN_SERVICE	0x04

9-17. L1_FRAMING

This field specifies the type of framing to set when MTP3 Stub receives M2_OPEN request. These codes are used on the Cross Bus Interface (CBI) only.

CBI_L1_FRAMING	Value
CBI_L1_FRAMING_NONE	0
CBI_L1_FRAMING_E1	1
CBI_L1_FRAMING_T1	2

9-18. L1_CLOCKING

This field specifies the type of clocking to use on the L1 framers. Used on Cross Bus Interface (CBI) only.

CBI_L1_CLOCKING	Value
CBI_L1_CLOCKING_LOOP	1
CBI_L1_CLOCKING_LOCAL	2
CBI_L1_CLOCKING_THROUGH	3

9-19. L1_LINE_TYPE

This field specifies the physical line type for each of the framers on the line card.

CBI_L1_LINE_TYPE	Value
CBI_HM_DS1LF_D4	1
CBI_HM_DS1LF_D4_MF	2
CBI_HM_DS1LF_ESF	3
CBI_HM_DS1LF_ESF_MF	4
CBI_HM_DS1LF_E1	5
CBI_HM_DS1LF_E1_CRC	6
CBI_HM_DS1LF_E1_MF	7
CBI_HM_DS1LF_E1_CRC_MF	8

9-20. L1_LINE_CODE

This field specifies the line code for each of the framers on the line card.

CBI_L1_LINE_CODE	Value
CBI_HM_DS1_PHYS_ENC_B8ZS	1
CBI_HM_DS1_PHYS_ENC_AMI	2
CBI_HM_DS1_PHYS_ENC_HDB3	3

9-21. L1_LINE_BUILD_OUT

This field specifies the line build out for each of the framers on the line card. In E1, this is the line impedance. In T1, it is the line length in feet.

CBI_L1_LINE_BUILD_OUT	Value
CBI_HM_DS1_E1_IMPEDANCE_75_OHM	1
CBI_HM_DS1_E1_IMPEDANCE_120_OHM	2
CBI_HM_DS1_E1_IMPEDANCE_75_OHM_HIGH	3
CBI_HM_DS1_E1_IMPEDANCE_120_OHM_HIGH	4
CBI_HM_DS1_T1_LINE_LEN_0_TO_133FT	1
CBI_HM_DS1_T1_LINE_LEN_133_TO_266FT	2
CBI_HM_DS1_T1_LINE_LEN_266_TO_399FT	3
CBI_HM_DS1_T1_LINE_LEN_399_TO_533FT	4
CBI_HM_DS1_T1_LINE_LEN_533_TO_655FT	5

10. Appendix C: Manpages

Manpages in HTML format are available on the CDROM. These files are located in the </manpages/> directory off of the CDROM's main directory. The front page of the CDROM has a reference link to the manpage index file <manpages/manpages.htm>.

When the package is installed on a system, the manpages index and files can be found at directory </opt/SBEhw/doc> as a file </opt/SBEhw/doc/manpages.htm>. The manpages are also installed in nroff format in the standard user man directories.

10-1. Table of Manpages

Table 10-1 lists the manpages included with HighWire MTP2.

Table 10-1 Manpages

Maintenance Commands	
hw_daemon(1M)	SBE HighWire Support Package Multi-Board Control Daemon
hwcmd (1M)	SBE HighWire Support Package Command Utility
hwinfo (1M)	SBE HighWire Support Package Information Display Utility
hwstat (1M)	SBE HighWire Support Package Statistics Display Utility
highwire.rcm(1M)	script for Reconfiguration and Coordination Manager support
wspcmd (1M)	SBE HighWire Support Package Commander Utility
wspd (1M)	SBE HighWire Support Package Controller Daemon
SBE libsbe Library Functions	
libsbe (3)	SBE HighWire Support Package Standard Library
sbe_BoardReady (3X)	used to determine if a board is ready to receive messages
sbe_CtlOpen (3X)	initialize the HighWire control device library
sbe_CtlClose (3X)	clean up the HighWire control device library
sbe_CtlIssueMsg (3X)	send an Ioctl to the SBE HighWire control device
sbe_CtlRcvMsg (3X)	receive an Ioctl from the SBE HighWire control device
sbe_dataOpen (3X)	open the HighWire Streams data device for reading or writing

Table 10-1 Manpages (continued)

Data Path Routing Functions	
libdpr (3SBE)	SBE HighWire Data Path Routing (DPR) Service Support Package
sbe_dprOpen(3SBE)	open a connection to the DPR service
sbe_dprClose(3SBE)	close a connection to the DPR service
sbe_dprRead(3SBE)	read the current DPR connection matrix
sbe_dprWrite(3SBE)	write the supplied DPR connection matrix and make it the current one
sbe_dprIoctl(3SBE)	change individual DPR connections and dynamic parameters
sbe_dprConfigDefault(3SBE)	set up the default DPR configuration
sbe_dprConnectionReport(3SBE)	print the DPR connection matrix
sbe_dprHighwayReport(3SBE)	print the DPR time slot assignments for the highway
sbe_dprPrint(3SBE)	print the DPR connection matrix and the time slot assignments for the highway
File Formats	
wsp.conf (4)	SBE HighWire Driver configuration file
wspcmd.cfg (4)	wspcmd protocol reporting selector database
Demonstration Programs	
cbiDemo(6)	SBE HighWire MTP2 Support Package Demonstration Utility
cbiptest(6)	SBE HighWire MTP2 Support Package Test Utility
dprDemo(6)	SBE HighWire/LinkWARE Data Path Routing Demonstration Utility
Device Driver	
dprservice(7D)	SBE HighWire Data Path Routing (DPR) Service Description
wsp (7D)	SBE HighWire Driver with HW200/400 support

11. Appendix: cbiDemo.c and dprDemo.c

11-1. cbiDemo.c

The cbiDemo.c file can be used as the framework for applications which transport data across the HighWire MTP2 CBI Interface. The file is located at /opt/SBEhw/src/cbi_demo/... and is installed by the HighWire MTP2 Software Package.

The directory also contains all required elements needed to recompile the application. However, since the unbundling of the Solaris Compilation subsystem, it is at the discretion of your System Administrator to determine the path that developers required for accessing the development environment. This may required that the CC32 and CC64 definitions within cbi_demo/Makefile be modified to resolve access.

11-2. dprDemo.c

The dprDemo.c file can be used as the framework for applications which require program of the Data Path Routing Interface (DPR). The file is located at /opt/SBEhw/src/dpr_demo/... and is installed by the HighWire MTP2 Software Package.

The directory also contains all required elements needed to recompile the application. However, since the unbundling of the Solaris Compilation subsystem, it is at the discretion of your System Administrator to determine the path that developers required for accessing the development environment. This may required that the CC32 and CC64 definitions within dpr_demo/Makefile be modified to resolve access.